SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JULY, 1927.

GENERAL PHYSICS.

1956. *Density of Water Vapour.* **T. Shirai.** (Chem. Soc. Japan, Bull. 2. pp. 37–40, Feb., 1927.)—Few previous direct investigations of the molecular state of water vapour have been made, the molecular state being usually deduced from indirect observations such as vapour pressure and heat of vaporisation. This paper deals with a direct determination based on the gas law $PV = WRT/M$, where P is the pressure exerted by W grammes of water vapour at the temperature T, M is the required molecular weight, and $R = 0{\cdot}082068$ litre-atmosphere. No deviations greater than 1 % of the calculated value ($M = 18{\cdot}016$) are obtained, hence it is concluded that water vapour consists of single molecules only. G. E. B.

1957. *Gauge for the Measurement of High Vacua.* **R. E. Burk.** (J. Phys. Chem. 31. pp. 591–595, April, 1927.)—It is pointed out that the McLeod gauge is not suitable for use at pressures below 10^{-5} mm. Hg, whilst for lower pressures the Knudsen and molecular gauges are fragile and difficult to construct, the Dushman ionisation gauge being useless in chemically sensitive systems. A gauge is described which can be used with any gas, or any vapour whose vapour pressure is large compared with that of Hg. It is easily constructed and simple in operation, having no metal parts, and can be calibrated *in situ* without previous knowledge of its dimensions. The construction combines the principles of the ordinary manometer, the McLeod gauge, and the quartz fibre manometer, and is capable of measuring pressures from several decimetres to 10^{-7} mm. Hg. A specially designed high-capacity, two-way stop-cock useful in working with high vacua is described. A. B. C. L.

1958. *An Acceleration Seismometer.* **T. Tamaru.** (Imp. Acad. Tôkyô, Proc. 3. pp. 35–40, Jan., 1927.)—A new instrument has been constructed to satisfy the following conditions. A mass is to make practically the same motion as the earth, and the force acting on the mass is recorded by mechanical means. The apparatus possesses sensibility to small vibrations and also records near earthquakes by having a non-uniform scale of motion. A diagram of the mechanism is given, and it is possible for the same mass to give records of all three components. W. A. R.

1959. *Further Experiments with the Ewing Ball-and-Tube Flowmeter.* **J. H. Awbery** and **E. Griffiths.** (Roy. Soc. Edinburgh, Proc. 47. 1.

pp. 1–10, 1926–1927.)—Reference is made to Ewing's method and the results obtained. [See Abstract 8 (1926).] The tube is calibrated for different rates of flow for water, medicinal paraffin oil, thin lubricating oil and a mixture of glycerine and methylated spirit, the results being shown graphically. For any one position of the tube different rates are found for different liquids. From conditions of dimensional similarity an equation is built up for equilibrium of the sphere in the tube. Tests were also made with the same apparatus for air, CO_2 and H_2. It is concluded that it is not possible by any simple means to deduce the calibration for one liquid by means of that for another unless the variable $d^3(\rho - \sigma)/\nu^2\sigma$ is the same for both. In general, this is impossible to obtain, since at the same time D/d has to be constant. Here D and d are the respective diameters of tube and sphere, ρ and σ the densities of sphere and fluid, and ν the kinematic viscosity of the fluid. Failing this the calibration must either be made with the liquid to be used, or the whole series of curves drawn for all values of D/d. R. S. R.

1960. *Laws of Viscosity of Fluids.* **J. Dublef.** (J. de Physique et le Radium, 7. pp. 402–413, Dec., 1926.)—At present there exists only a law expressing the viscosity of a fluid as a function of pressure and density. The Maxwell relation is only applicable to perfect gases: actual fluids depart from it as they deviate from Boyle's law. Kinetic theory permits the calculation of a simple relation valid for gases and liquids

$$\eta = \eta_0 \frac{v}{v - b},$$

where η = viscosity of fluid, η_0 = viscosity of perfect gas, and b = van der Waals' co-volume. From this the equation of state is derived:

$$pv = \left(1 - \frac{\gamma\phi(\mathrm{T})}{v}\right)\frac{\eta}{\eta_0}\mathrm{RT} - \pi,$$

where π is a linear function of density, which is an extraordinary function in that it is not continuous but increases in jumps. J. E.

1961. *Viscosity of Ether at Low Temperatures.* **E. H. Archibald and W. Ure.** (Chem. Soc., J. pp. 610–614, March, 1927.)—The results are given of measurements of the viscosity of ether at 10° intervals over the temperature range 0° to − 110° by means of a viscometer of the Ostwald type. The viscosities are calculated from the observed times of flow in the same manner as in the previous paper [Abstract 1648 (1924)], use being made of the equation

$$\eta = \frac{dt}{d_w t_w}\left(\eta_w + \frac{md_w\mathrm{V}}{8\pi l t_w}\right)\{1 - 0{\cdot}000008(0 - t)\} - \frac{md\mathrm{V}}{8\pi l t},$$

where η is the coefficient of viscosity of the liquid, V the volume of liquid flowing through the capillary in time t, d the density of the liquid, l the length of capillary and m a constant = 1·12; the subscript w refers to water. As with acetone, the viscosity-temperature curve rises very steeply at the lower temperatures. T. H. P.

1962. *The Kinetic Theory of the Eötvös Law in Surface Tension.* **M. Satô.** (Tôhoku Univ., Sci. Reports, 15. pp. 805–817, Dec., 1926. Paper read before the Math. Phys. Soc., Japan, April, 1926. In English.)—The molecular mechanism involved when a film of liquid is cooled by stretching is considered. The movements of molecules in a thin film are analysed and a physical interpretation of the Eötvös law is based on the analysis. Cohesive forces in liquids calculated from the surface tension are compared with those obtained by application of van der Waal's equation. Both methods give values of the same order of magnitude. **L. M. C.**

1963. *Phenomena of Intertraction.* **A. E. Wright.** (Roy. Soc., Proc. 114. pp. 576–591, April 1, 1927.)—The paper constitutes a reply to a criticism by N. K. Adam [see Abstract 861 (1927)] of a previous paper on this subject. The paper deals with the "drawing" action of hypertonic salt solutions on the lymph glands and its action in contact with serum. **A. B. W.**

1964. *Application of the Kinetic Theory to Surface Films.* **K. C. Sen.** (Phil. Mag. 3. pp. 925–930, April, 1927.)—The application of the gas law $pv = RT$, which, as Langmuir had shown, could be used to draw an analogy between the behaviour of a gas and the surface film on a liquid, is discussed. The experimental results of the effects of dimethylaniline on the interfacial tension between benzene and water and heptane and water were used to calculate the numerical data. For relatively weak solutions the equation $F(A - B) = x\mathrm{RT}$, analogous to that of Amagat, connecting the pressure and volume of highly compressed gases, is obeyed by surface films. The equation does not hold when the films are not unimolecular. **F. J. B.**

1965. *Extension and Compressibility Coefficients of Liquids.* **V. S. Vrkljan.** (Zeits. f. Physik, 40. 3–4. pp. 270–277, 1926.)—Experimentally confirms his former deductions [see Abstract 2237 (1926)] as to calculating the extension coefficients from the compressibility coefficients. **A. D.**

1966. *Flow of a Liquid from Rest into a Moving Liquid.* **R. Mazet.** (Comptes Rendus, 184. pp. 799–802, March 28, 1927.)—Mathematical. Obtains an integral equation for the velocity potential in the initial stages of motion through a gradually opened orifice into moving liquid. **Errata** (*ibid.*, p. 960, April 11, 1927). **W. G. B.**

1967. *Movements of Fluids in Porous Solids.* **P. G. Nutting.** (Frank. Inst., J. 203. pp. 313–324, Feb., 1927.)—The forces acting in tubular pores or pores of lamellar shapes (crevices) are capillarity, hydrostatic head, atmospheric pressure, trapped gases and weight of the liquid. The formulæ deduced are essentially those of Washburn [see Abstract 993 (1921)] and of Guye [see Abstracts 211 and 212 (1926)]. The maximum heights reached by water and by a mineral lubricating oil in pores of radius 0·1 mm. (or 1μ) are 14·7 (1470) cm. and 7·6 (760) cm.; to penetrate 10 cm. horizontally in crevices of those thicknesses would take water 2·8 sec. (4·7 min.) and oil 11 min. (18 hrs.). Water would rise 30 ft. in vertical tubular pores of 3·2μ diameter and would reach that same maximum height in crevices of 1·6 μ thickness. The height values are increased when the sea sand is previously dried or treated with caustic soda and sodium carbonate (still stronger effect); but for solutions of sodium carbonate (instead of water) the figures remain little changed until the concentration is high. Crushed oil sands differ from sea sands. In coarse sand the rise consists of a rapid creep over each grain followed by a slow leap over to the next grain; in sandstone the walls are moist far in advance of the rising fluid. Very finely-divided solids are almost impenetrable to water, unless they are free to expand. The effective mean pore diameter in consolidated sandstones is approximately determined by dipping a slab of a thickness of $2 \cdot 5$ cm. in water and by noting the time of the appearance of water on the upper surface; care must, however, be taken in preparing the faces not to fill the pores with débris. H. B.

1968. *Stability of an Infinite Series of Circular Vortices.* **H. Levy** and **A. G. Forsdyke.** (Roy. Soc., Proc. **114.** pp. **594–604,** April 1, 1927.)—A system of equal circular vortex filaments have their centres evenly spaced along a straight line and their planes at right angles to this line. The present paper deals with the stability or instability of such an arrangement. The corresponding problem in two dimensions has been dealt with by Kármán [see Abstract **294** (1912)], who considered the case of two infinite trails of parallel rectilinear vortices. The present paper is a first step towards an examination of the three-dimensional problem, analogous to that treated by Kármán. A. B. W.

1969. *From Hydrodynamics to Hydraulics: Turbulence in Gases and Liquids.* **M. Brillouin.** (Ann. de Physique, **7.** pp. 184–204, March–April, 1927.)—After pointing out that hydraulics is interested in the large-scale or mean motion of a mass of fluid, while the hydrodynamical equations apply to the complicated small-scale motion, an analysis of the motion by means of averaging the hydrodynamical equations over a volume is undertaken in more detail than in the work of Reynolds. In addition to the pressure-viscous tensor, there is a "flux of conduction" which appears in the final equations, and this is, at present, not taken into account in hydraulics. Some tentative suggestions are made as to the possibility of optical means of determining variations from the mean motion experimentally. W. G. B.

1970. *Representation of Plane States of Strain by Means of Angular Conceptions.* **A. Nádai.** (Zeits. f. Physik, **41.** 1. pp. 48–50, 1927.)—Two cases of the plane problem of an elastic body are discussed in which the distribution of strain is derived by means of a contour application of potential theory. The author claims to have used this method prior to the publication of Carothers [see Abstract **660** (1920)], in which similar conceptions are recorded. H. H. Ho.

1971. *Elliptic Functions.* **G. Greenhill.** (Phil. Mag. **3.** p. **270,** Jan., 1927.)—Draws attention to the existence of elliptic function tables (ten figures) in Appendix XI of *Smithsonian Mathematical Formulæ.* W. H. Gr.

1972. *Forced Vibrations as Affected by Air-filled Enclosures.* **G. Schweikert.** (Zeits. f. Physik, **41.** 10. pp. 775–786, 1927.)—A mathematical investigation of a stiff but elastic membrane moving, piston-like, in (*a*) a tubular air space of unlimited length, (*b*) a flat, completely closed air space, and (c) a similar enclosure with fine openings in its thin walls. The conditions for good resonance are discussed. G. E. A.

1973. *Foundation of the Ergodic Hypothesis on the Theory of Probability.* **P. Höflich.** (Zeits. f. Physik, **41**. 8–9. pp. 636–674, 1927.)—The paper commences with a general discussion of the ergodic hypothesis, *i.e.*, of the assumption that a mechanical system in the course of time passes through all states compatible with its total energy. § 1 then considers some fundamental conceptions of physical statistics and thermodynamic analogies; § II discusses the fundamental equations of statistical mechanics in conjunction with ergodic systems; § III, § IV and § V deal with the ergodic, quasi-ergodic and pseudo-ergodic hypotheses; § VI derives the proof on the probability hypothesis under the sub-sections of circles (the basis of all the conclusions drawn), spherical surfaces, spheres of n dimensions, and cylinders of different dimensions; § VII considers the energy surfaces of warm bodies, *viz.*, of the rigid body and the ideal gas. The paper is entirely mathematical. H. H. Ho.

1974. *Methods of Statistical Mechanics.* **R. C. Tolman.** (Frank. Inst., J. **203**. pp. 489–508, April, 1927.)—In this lecture report the methods of statistical mechanics are first compared with those of ordinary mechanics and then with those of thermodynamics, the sources of lack of rigour in the methods of statistical mechanics being discussed at length. Attention is then given to the results that can be achieved by the various methods, the balance being shown to be in favour of the newer science. Following these comparisons, the author proceeds with the development of statistical mechanics dealing with: Ensemble and Phase; Phase Spaces; Distribution of the Ensemble in Phase; Change in Density of Distribution with the Time; Liouville's Theorem; Application to Molecular Systems; Introduction of the Ergodic Hypothesis. The whole is treated in a very lucid manner and will well repay consultation. H. H. Ho.

1975. *Philosophical Foundations of Quantum Theory.* **P. Jordan.** (Nature, 119. pp. 566–569, April 16, 1927.)—The author considers first the rôle of causality in the classical physics of the field, and discusses the theoretical justification of physical determinism. It is shown how one must be prepared to lose this determinism in the transition from classical physics to the quantum theory. Attention is then directed not to discrete discontinuous details, but to the corresponding probabilities, the introduction of which brings about a return to continuous variables, and thus to classical terms. There appears, in consequence, a principle of determinism to exist for these continuous probabilities not very different from the classical principle. Born's probability function for the representation in discontinuous confusion of quantised atomic processes by differential equations is next considered. Return is then made to the problem of the discontinuous elementary phenomena; it is shown that quantum theoretical probabilities must be reduced to independent elementary probabilities for the understanding of physical laws, since only then can it be known exactly what is causally determined and what is left to chance. H. H. Ho.

1976. *Quantisation of the Symmetrical Top According to Schrödinger's Undulation Mechanics.* **H. Rademacher** and **F. Reiche.** (Zeits. f.

Physik, 41. 6–7. pp. 453–492, 1927.)—Continues the previous paper [see Abstract 903 (1927)] dealing with the intensities of the spectral lines and the selection rules, by forming the Heisenberg, Born, Jordan matrices of the electrical moment. The results obtained are in some ways similar to those of D. M. Dennison, the energy values differing only by a constant which is independent of the quantum numbers; the intensities agree, but Dennison concludes that the three quantum numbers j, τ, τ', which he writes m, n, σ, are either all three whole numbers or differ all from whole numbers by one-half; the authors conclude that they are whole numbers unless the rotations of the electrons are taken into account. Formulæ are obtained by the method of matrices for the intensities and frequencies in the case of deformations of a molecule or " top " free from disturbances, which depend only on the two quantum numbers j and τ. Nine different jumps are considered, but one of these has frequency zero; in the other cases the frequency may be positive or negative, or even zero. The intensity formulæ for such a molecule are identical with those previously obtained by Hönl by an extension of the correspondence principle, before the introduction of quantum mechanics. For the case where j, τ and τ' have to be reckoned with, formulæ are given by means of which the intensities for the twenty-seven possible jumps can be calculated. These are due to the combinations of the following possible alterations in the quantum numbers: $\Delta j = -1, \Delta j = +1, \Delta j = 0$; $\tau_2 = \tau_1 + 1$, $\tau_1 - 1$ or τ_1; $\tau'_2 = \tau'_1 + 1$, $\tau'_1 - 1$ or τ'_1. The Thomas, Kuhn summation law and the durations of the vibrations (*Abklingunszeiten*) are dealt with. **H. N. A.**

1977. *Statistical Interpretation of Quantum Mechanics.* **P. Jordan.** (Zeits. f. Physik, 41. 11–12. pp. 797–800. 1927.)—Previously [see Abstracts 1229 (1926), 1289 and 1290 (1927)] it has been shown that by means of certain linear differential equations functions can be defined which, if accepted, determine certain quantum mechanical *à priori* probabilities. Based on this work, the author now shows that the probability of a quantity q lying within a certain interval dq is independent of the scale in which the q quantities are measured. **H. H. Ho.**

1978. *The Physical Interpretation of the Equation for the Quantisation of Continuous Systems.* **T. de Donder.** (Comptes Rendus, 184. pp. 810–811, March 28, 1927.)—Deduces two equations which define the statistical changes to which continuous molecular systems, forming a luminous source whose spectrum is governed by the fundamental equation for ψ of de Broglie and Schrödinger, are subject. [See Abstract 308 (1927).] Conversely it is possible to deduce rigorously the fundamental equation from the above statistical laws by means of Einstein's gravitational theory. **H. N. A.**

1979. *Undulation Mechanics of the Molecular Ion of Hydrogen.* **W. Alexandrow.** (Ann. d. Physik, 82. 5. pp. 683–688, March 22, 1927.)—Some of the conclusions arrived at in a former paper [see Abstract 305 1927)] have been found to be unjustifiable; the value 2·9 volts taken for the energy of dissociation is too low, according to the latest results, and other defects in the theoretical treatment are noted. The author attempts in three different ways to deal with the second equation of his previous paper, but has not as yet succeeded in obtaining a satisfactory solution of the problem. **H. N. A.**

1980. *Molecular Models for Methane and Other Compounds. Parts I and II.* **J. H. de Boer** and **A. E. van Arkel.** (Zeits. f. Physik, 41. 1. pp. 27–47, 1927.)—In a previous paper the authors have given arguments to show that in CH_4 and all other organic compounds of carbon and hydrogen, and further in SiH_4 and similar compounds, the properties can be best explained by assuming that the hydrogen exists as negative ions. [See Abstract 2980 (1926).] An attempt is now made to calculate the energy relations of the methane model and those of chloroform and methyl chloride from this point of view. A formula is obtained, based on the assumption that the negative hydrogen ion is polarisable in Born and Heisenberg's sense, giving the value of ϕ, the total energy of the molecule (in volts), in terms of e, the charge of an electron, r the distance between C and H, n in the expression B/r^n for the repulsive force, and α the polarisability. On certain assumptions as to the values of r, α and n, for which the reasons are given, the value of $\phi = 181$ volts is obtained. From the heat of formation of CH_4 an estimate of ϕ is made by means of a cyclical process, the value being 149 volts. It is not considered that the difference in the two values is due to the n value chosen, and it is suggested that the α value calculated from the refraction is too large. A similar discrepancy is found for the methyl chloride model and is explained in the same way. Criticises Guillemin's model, in which the H ions are assumed to be negative. H. N. A.

1981. *Non-Equilateral Triangular Systems of Rutherford-Bohr.* **U. Crudeli.** (N. Cimento, 4. pp. 85–93, Feb., 1927.)—The study of the Rutherford-Bohr triangular systems having an important bearing on the question of models of the helium atom, the author's object is to show the results consequent on the general hypothesis of mutual action in the direction of the straight line joining the two acting points and the magnitude depending on the product of the corresponding charges by the inverse of a power of the mutual distance (a power with a negative exponent). Denoting with m the magnitude of the masses relative to the two vertices bearing equal charges and with M the charge of the other vertex, which will be called the nucleus, it will be seen that, abandoning the Coulombian hypothesis, we have neutral, non-equilateral, uniformly rotating Rutherford-Bohr triangular systems provided on the two vertices with equal charges and masses, which, however, are not compatible with values of the ratio m/M less than unity. A general treatment is also given of the Rutherford-Bohr triangular systems in relative equilibrium, provided with equal charges and masses on the two vertices, on the supposition that the sides uniting the third vertex with the other two are unequal. The treatment includes, as a special case, the Coulombian hypothesis developed in a previous paper. [See Abstract 234 (1926).] Entirely mathematical. E. F.

1982. *Structure of the Atom according to Mainsmith-Stoner.* **M. N. Saha** and **B. B. Ray.** (Phys. Zeits. 28. pp. 221–225, March 15, 1927.)—Stoner [see Abstract 38 (1925)] accounts for the existence of two absorption edges L_{21} and L_{22} by the assumption of two L levels. This assumption is unnecessary if Bohr's scheme is combined with the synthetic electronic paths of Pauli. [See Abstract 1875 (1925).] There is only one L_2 level with six electrons. When one electron is removed, the remaining five give either $2P_1$ or $2P_2$ orbits; this splitting is dynamic, and not, as Stoner assumed, static and pre-existent. This is shown with reference to the spectra of tungsten, aluminium and silicon, the intensity relations being deduced after Ornstein-Sommerfeld. Similar considerations apply to the M_3 level, and further to the spark lines in Röntgen spectra. Wentzel [see Abstract 1415 (1925)] had attempted to explain the K-spark spectra of Al and Mg by the simultaneous removal of two electrons from the K_1 shell. The authors suggest the simultaneous removal of one electron both from the K_1 and the L_2 shells, which would agree with the experiments of Bäcklin and Larson [see Abstract 2780 (1924)] on the intensity relations of the excitation of spark lines. H. B.

1983. *Present State of the Physics of the Atom.* **A. Sommerfeld.** (Phys. Zeits. 28. pp. 231–239, March 15, 1927)—The quantum mechanics of Heisenberg is a discontinuum theory based upon the view that the description of physical phenomena should merely rely upon observational data, such as the frequency and the intensity of the oscillations of the lines of the spectrum, but not upon the instantaneous positions of electrons and their orbital periods, which cannot be ascertained. This theory has been developed with remarkable success by Born-Jordan, Dirac and Pauli, but its mechanism is very abstract. On the other hand, Schrödinger has attempted to formulate a continuum theory based upon a wave mechanics not admitting of experimental control of single conditions. The two theories come to the same results. Physicists object to both that the equations have no physical meaning, as they had objected to Maxwell's mathematics, and to the relativity theory. The author discusses various phenomena from these standpoints. The accepted form of causality might not stand; but there was no reason for pessimism nor any question of abandoning Bohr's theory. H. B.

1984. *Variation of the Atom Form Factor with the Wave-Length of the Scattered Radiation.* **G. Greenwood.** (Phil. Mag. 3. pp. 963–972, April, 1927.)—Theoretical calculations show that F, the atomic structure factor, is a function of sin θ/λ. [See Hartree, Abstract 2020 (1925).] Measurements of F curves for calcium and fluorine, etc., have been carried out by James and Randall [see Abstract 2121 (1926)], etc. The experimental work up to date has been concerned with the relation between F and θ. This investigation is an attempt to correlate F with θ. The powder method is used and the films photometred, intensities being deduced by comparison with a calibrated film. Details are given as to the method of evaluating results and of the correction factors employed. While no claim is made for great accuracy (and it is pointed out that the ionisation method would be more reliable), the results show that F is a function of sin θ/λ, as theory indicates. J. E.

1985. *Elements of Atomic Numbers, 43, 61, 75, 85, 87.* **Herszfinkiel.** (Comptes Rendus, 184. pp. 968–970, April 20, 1927.)—All these elements of odd atomic numbers would probably be very rare. The author, together with Lobanow and Dauvillier, has examined highly complex ores of the iron and platinum groups; he briefly reviews the controversial literature on the subject. Most of these elements have been found, and different names have been proposed for several of them. In the case of 85 and 87 the special searches by O. Hahn, Fajans and the author have all been in vain. H. B.

1986. *Crystal Structure of Magnesium Di-Zincide.* **J. B. Friauf.** (Phys. Rev. 29. pp. 34–40, Jan., 1927.)—Laue photographs and rotation photographs were taken of $\mathrm{MgZn2}$. The crystals are found to have hexagonal axes with $a = 5\cdot15$ Å. and $c = 8\cdot48$ Å. The unit cell contains four molecules. The effect of absorption in determining the wave-length giving maximum intensity in the Laue photographs was used to confirm the dimensions of the unit cell. The positions of the atoms are given. The least distance between two Mg atoms is 3·16 Å. and between two Zn atoms 2·52 Å. and between Mg and Zn atoms 3·02 Å. **J. E.**

1987. *Sizes of Ions and Structure of Ionic Crystals.* **L. Pauling.** (Am. Chem. Soc., J. 49. pp. 765–790, March, 1927.)—Using an atomic model derived from the wave mechanics of Schrödinger, values of the radii of ions in crystals are derived. The radii for eight shell ions are in agreement with observed interatomic distances for normal alkali halide crystals. Excellent agreement is also found with alkaline earth oxides, sulphides, selenides and tellurides with the NaCl structure for the alkaline earth oxides and sulphides and for quadrivalent oxides with the fluorite and rutile structures. In LiCl, LiBr, LiI and MgS, MgSe and $\mathrm{SrCl_2}$ the interatomic distances depend on the anion alone, for the anions are in mutual contact; the observed anion-anion distances agree satisfactorily with those calculated. Agreement is also found in eighteen shell ions. A theoretical result is derived that ionic compouuds $\mathrm{MX_2}$ will crystallise with fluorite structure if $\mathrm{Rm/Rx} > 0\cdot65$ and with rutile structure if less. This is experimentally substantiated. Also a binary component should have the sphalerite or wurzite structure if $\mathrm{Rm/Rx} < 0\cdot33$. It is found that tetrahedral structures are apt to show deformed ions, and it is suggested that this is due to a tendency of the anion to share an electron pair with each kation. A brief discussion of crystals containing complex ions is given. **J. E.**

1988. *Behaviour of Aluminium Crystals on Stretching. Part I. Theoretical.* **v. Göler** and **G. Sachs.** *Part II. Experimental.* **R. Karnop** and **G. Sachs.** (Zeits. f. Physik, 41. 2–3. pp. 103–139, 1927.)—Taylor and Elam [see Abstract 2736 (1926)] and their co-workers have investigated the behaviour of aluminium crystals under homogeneous uniaxial tensions. The first paper here shows how the glide planes and the direction of gliding can be related to the directions of strain and the geometry of the crystal. Gliding takes place in steps in such a way that the atoms merely shift to new lattice points, the volume of the unit cell remaining unaltered. On this basis the kinematics of gliding, single and double, is worked out and diagrams evolved for calculating the extensions and stresses. The second paper (experimental) deals with the strength of the variously orientated aluminium crystals. The stress curves for the various crystals are very similar in the middle region. Crystal bars whose axis is nearly parallel to a cube diagonal have a resistance 10–15 % greater than the others. The beginning of constriction, as determined by experiment and also theoretically, shows good agreement. The observed change of cross-section is a little different from that calculated. **J. E.**

1989. *The Connection between Pictet's Rule and Born's Theory.* **W. Tarassoff.** (Zeits. f. Physik, 41. 4–5. pp. 318–325, 1927.)—The existing theory of the crystal lattice can be regarded as the electrostatic theory of solids; it deals with particles at rest and gives an ideal picture of the properties of a solid at 0° abs. Using Born's equation for the forces between the ions in a lattice of the NaCl type, the author derives an expression for the so-called quasielastic force of a given ion with regard to its two neighbouring ions, *i.e.*, the total force acting on it when it is displaced by a distance ρ away from one of them and towards the other. The melting point is the temperature at which, owing to the increase in the distance between the ions, the quasielastic force vanishes, and the author shows from Born's theory that $(R_s - R_0)/R_0 = 0{\cdot}038$ within 4 %, where R_0 is the distance between the ions at absolute zero and R_s at the melting point. The coefficients in the equation for $(R_s - R_0)/R_0$ are the same for all heteropolar lattices, of the same type, so that this quantity is a constant. It is shown that it can be assumed that αT_s is approximately equal to $(R_s - R_0)/R_0$, so that Pictet's rule that αT_s is a constant, where α is the mean coefficient of linear expansion and T_s the absolute temperature of the melting point, is confirmed. H. N. A.

1990. *Nature of the Recrystallisation Nucleus in Metals.* **A. E. van Arkel** and **P. Koets.** (Zeits. f. Physik, 41. 8–9. pp. 701–707, 1927.)—Mechanical deformation has the effect of facilitating the transformation of α iron $\rightarrow \gamma$ iron by increasing the number of centres of change. A difference in the grain size affects both the $\alpha \rightarrow \gamma$ change and the $\gamma \rightarrow \alpha$ change. This shows that the recrystallisation nuclei and the transformation nuclei are of the same nature, and that it is more probable to assume that the nuclei are points at which the lattice is most distorted rather than points at which it is least distorted. J. E.

1991. *An Optical Method for Investigating Plastic Deformations in Rock-Salt.* **I. W. Obreimow** and **L. W. Schubnikoff.** (Zeits. f. Physik, 41. 11–12. pp. 907–919, 1927.)—Explains, with the help of photographs of the appearances observed, how polarised light may be employed in the study of these deformations in a similar manner to that used for investigating strains in transparent structural models. In one crystal a tension of 230 kg./cm.^{2} was found—an astonishingly high value, since, according to Joffé, the elastic limit of rock-salt at room-temperature is only 900 g./mm.^{2}. A method is described in which carefully annealed specimens were tested optically in tension. In certain crystals the first slip surfaces became visible at tensions between 69 and 78 g./mm.^{2}. H. N. A.

1992. *Torsion of Circular and Elliptical Cylinders of Homogeneous Æolotropic Material.* **S. J. Wright.** (Phil. Mag. 3. pp. 565–570, March, 1927.)—In a paper on the behaviour of single crystals of aluminium under reversed torsional stresses [see Abstract 546 (1927)] it was assumed that the stress system existing in a circular bar, consisting of a single cubic crystal of arbitrary orientation, when twisted about its axis by terminal couples, was the same as that which would exist if the material were isotropic. The stress system, due to the torsion of circular and elliptical cylinders of homogeneous but completely æolotropic material, has been worked out analytically, and it is found that the stress system in each of the above cases is precisely the same as that which would exist if the material were isotropic. C. O. B.

1993. *X-Ray Investigation of Certain Long-Chain Compounds.* **A. Müller.** (Roy. Soc., Proc. 114. pp. 542–561, April 1, 1927.)—Earlier work on X-ray analysis of long-chain carbon compounds and the results obtained are summarised. This was concerned with objects in powder form, and for much further progress well-developed crystals were necessary. The crystals used were of stearic, Br-stearic, stearolic and behenolic acid, all being of the monoclinic prismatic form. The following general formula applied: $CH_3(CH_2)_mA$ or $CH_3(CH_2)_nCH \vdots CH(CH_2)_pA$. The two former bodies belonged to the *n*-saturated series and the two latter to the *n*-unsaturated. The molecule consists of two parts, one of which, called the chain or hydrocarbon chain, contains a relatively large number of CH_2 groups and an X-ray investigation of a few typical representatives is likely to lead to the crystal structure of a large number of chemically similar bodies. The methods of obtaining the crystals and the X-ray technique are explained, and tables give the numerical data obtained. The general structure of the simple cell is considered and the probable structure of stearic acid discussed. The chain theory obtains thus very strong support, and goniometric measurements, though very inaccurate, support it. The difficulties due to the formation of pseudo-crystals are examined, while finally the application of the results to very thin films on a water surface is investigated. R. S. R.

1994. *Deflection of Molecular Stream in a Magnetic Field.* **A. Leu.** (Zeits. f. Physik, 41. 8–9. pp. 551–562, 1927.)—The substances K, Na and Tl were tested by the Gerlach-Stern method. To prevent oxidation, the first two substances were melted into little balls under xylol and then washed in pure benzene before being placed in the heater. The pressure inside the apparatus was kept at less than 10^{-5} mm., and the absence of deflection of zinc and cadmium streams in the non-homogeneous field confirmed the fact that atoms of these elements have no magnetic moment. The moment of potassium and of sodium is that of one Bohr magneton, whilst that of thallium is a third of a magneton. [See also Abstract 559 (1927).] G. E. A.

1995. *Evaluation of the Images formed by the Magnetic Separation of Molecular Streams.* **O. Stern.** (Zeits. f. Physik, 41. 8–9. pp. 563–568, 1927.)—A discussion of the accuracy of the results obtainable from the measurement of the deviation of molecular streams in a magnetic field. It is concluded that the accuracy may be increased to such a point that the method will supply a control or even an improvement on that which utilises the Zeeman effect for measuring e/m, and will also give a new determination of "h." [See also Abstracts 2055 (1922), 473 (1925), 483 (1927) and preceding Abstract.] G. E. A.

1996. *A New Principle in the Dynamics of Light Quanta.* **K. Schaposchnikow.** (Zeits. f. Physik, 41. 4–5. pp. 352–354, 1927.)—A continuation of previous work. [See Abstract 905 (1927).] The motion of a light quantum with velocity $v < c$ is according to the equation $m\,dv/dt = F$, and when the velocity has the limiting value $v = c$, $c\,dm/dt = F$. If the two equations are regarded as, in a certain sense, formally identical, some remarkable consequences follow. G. E. A.

1997. *Basis of a Dynamical Theory for Electrons and Light Quanta.* **K. Schaposchnikow.** (Zeits. f. Physik, 41. 11–12. pp. 927–930, 1927.)—The author derives from Mezscherski's equations of motion the principles which he had applied in previous papers. [See Abstract 905 (1927) and preceding Abstract.] G. E. A.

METEOROLOGY AND GEO-PHYSICS.

1998. *Meteorological Analysis of Relative Lightning Hazard at Various Locations in Southern California.* **M. E. Dice.** (Oil Bulletin, 13. pp. 27–31, Jan., 1927.)—The mechanism of the thunderstorm is examined and its formation from the breaking of drops explained. Three classes of thunderstorms are considered with regard to their different origins: (1) Due to the heating of air near the ground by solar insolation; (2) due to the passage of cold fronts; and (3) due to forced ascent of air when blown towards headlands or mountains. Topography is the main factor in deciding the relative frequency of each type. The Pacific coast is less subject to thunderstorms than any other part of the U.S.A., and level areas near the sea the least of all. Inland, or near hills or headlands the risk increases. It is concluded that a thunderstorm survey should be made before selecting sites for plants or structures which are particularly susceptible to lightning. R. S. R.

1999. *Mechanism of Cyclones and Anticyclones.* **T. Kobayasi.** (Imp. Acad. Tôkyô, Proc. 3. pp. 72–75, Feb., 1927. In English.)—Since both cold and warm fronts are not evident in many cyclones, the author considers them as circular vortices. The lines of air flow relative to the travelling centre of the circular cyclone give the positions, at the surface, of the cold front and the boundary of the centripetal current. The warm front is always in the centripetal current. At the level where the winds blow along the isobars the lines of flow give a column similar to the "stream-line form section" in aerodynamics, but moving sideways. In the upper atmosphere the cyclone becomes a vortex in a stream with the pressure distribution a superposition of parallel and radial gradients. The height where the cyclone acquires the vortex-in-stream character was calculated for many cyclones and gave 2–3 km. for winter and 2·5–4 km. for summer. These heights form the limit of the layer influenced by the surface temperatures by turbulence and convection. W. H. Dines obtained smaller values, but this may be due to difference of latitude. For anticyclones the height is of the same order, but temperature distributions are less regular. A full account will appear in Tôkyô Univ., Aeronaut. Research Inst., Report, Vol. II. No. 20. R. S. R.

2000. *Study of Fulminating Matter: Examples of Spontaneous Decomposition.* **E. Mathias.** (Comptes Rendus, 184. pp. 565–568, March 7, 1927.)—Particulars are given of explosive matter, sometimes spherical in shape, seen during thunderstorms which exploded usually after expansion. I. Galli found a maximum frequency for diameters of 20–30 cm., but here cases up to 10 m. are mentioned. It is suggested that the fulminating matter maintains its spherical shape by a limiting electrostatic pressure. The globe disappears without explosion when the contrapressure is progressively decreased by dissipation of the charge into the ionised air and to conductors. R. S. R.

2001. *Study of Fulminating Matter. Is it Warm or Cold?* **E. Mathias.** (Comptes Rendus, 184. pp. 653–655, March 14, 1927.)—Details are given of several cases where balls of fire were seen during thunderstorms, but on explosion or contact little or no burning resulted. It is suggested that the ball acts as a fulminating substance which has absorbed sulphur and hydrocarbons, and becomes electrified as it explodes. A screen of water vapour is produced which stops the radiation of heat while showing luminous. Depending upon the thickness of the layer, the external heating will be nil, slight, or moderate. R. S. R.

2002. *Physical Theory of Meteors.* **F. A. Lindemann.** (Astrophys. J. 65. pp. 117–123, March, 1927.)—The paper forms a reply to criticisms by C. M. Sparrow [see Abstract 1534 (1926)] of Lindemann and Dobson's theory of meteors. It is stated that Sparrow's theory leads to impossibly large dimensions of meteors, as shown by the rate of evaporation. Data derived from *ballons sondes* agree closely with the author's calculations. The densities of the air at the same height, derived from the height of appearance and disappearance of the meteor, are in good agreement, which rules out Sparrow's fundamental assumption of the direct molecular impacts. General physical considerations, such as the process of dissociation of the air and of meteoric molecules, re-absorption of the radiated energy by the meteor, etc., are not consistent with Sparrow's theory. It is further stated that the objection to the application of the idea of adiabatic compression to the case of meteors and criticism of numerical calculations from this theory are not convincing. R. S. R.

2003. *Measurements of the Amount of Ozone in the Earth's Atmosphere and its Relations to Other Geophysical Conditions. Part II.* **G. M. B. Dobson, D. N. Harrison and J. Lawrence.** (Roy. Soc., Proc. 114. pp. 521–541, April 1, 1927.)—The results of simultaneous measurements of the amount of ozone in the upper atmosphere are tabulated for Oxford, Valentia, Lerwick, Abisko (N. Scandinavia), Lindenberg (Berlin) and Arosa (S.E. Switzerland), slight corrections being applied to get more satisfactory values than those in the earlier paper [see Abstract 1532 (1926)]. (1) The annual variation with a maximum in April and a minimum in October is confirmed. (2) The departure of the amount of O_3 from the mean is found to be greater for days of high H than for days of low H, while the effect is more marked on days of high magnetic character. (3) The connection found with sunspots in 1925 broke down in 1926, and more observations are required, of which those from Montezuma will be most useful. (4) O_3 content is low for anticyclones and high for depressions, while for the latter the value is higher in the rear than in the front; as if the origin of the air affected the amount of O_3. An even closer relation exists for pressure in the stratosphere than for that at the surface. (5) O_3 may exist at a level such as 10–20 km., and not only in the higher levels. The lower layer is probably connected with anticyclones and depressions, and the upper layer with solar and magnetic conditions and probably also with the annual variations. R. S. R.

ASTRO-PHYSICS.

2004. *The Stratification of the Planets with a System of Surfaces of Equal Density.* **R. Wavre.** (Comptes Rendus, 184. pp. 739–741, March 21, 1927.)—A continuation of a discussion of the subject in a recent paper [see Abstract 1678 (1927)]. Making certain plausible hypotheses as to the properties of the surfaces of equal density, the author has arrived at the conclusion that these surfaces will tend towards an ellipsoidal form when the centre is approached. Using results obtained by Volterra and by Dive, he concludes that these surfaces cannot satisfy the equation $R(\rho\theta) = g(\rho)h(\theta)$; that is to say, that they are not homothetic. **H. N. A.**

2005. *Some Systematic Features in the Distribution of Stars.* **F. H. Seares.** (Nature, 119. pp. 461–463, March 26, 1927.)—A study of the deviations (Δ) from the mean distribution of stars as expressed through values of log N_m [see Abstract 945 (1926)]. The Δ values for the same limiting magnitude and the same latitude exhibit a large-scale periodic fluctuation with longitude, those of maximum deviation being nearly the same for all magnitudes and in all latitudes up to 70°, the amplitude of the variation decreasing with increasing galactic latitude, with but little asymmetry of north and south. The author obtains the equation of condition, $\Delta = s + G + F \cos(\lambda - L) \pm k \cos(\lambda - L_0)$, where L is the longitude of the centre of the stellar system (assumed to have rotational symmetry), and F, G are functions of the latitude, the space density and L. This shows that the stars thin out with increasing distance; that the asymmetry between the north and south galactic hemispheres holds good only for stars brighter than the 14th magnitude. He also finds that the sun is distant 1200 parsecs from the stellar system centre as compared with Shapley's 25,000 parsecs from the Globular Cluster system centre, and generally that the systems of stars defined by successive limiting magnitudes differ in centring and orientation. He compares his results with those of Walkey, Charlier, Nort, Shapley (for BO–B5 stars brighter than 5·5 mag.) and Hubble (for the nearer diffuse nebulæ) by a diagram, finding a continuous progression in the longitude of the centre and in the position of the galactic pole through successive limits of brightness. **A. S. D. M.**

2006. *Stellar Spectra of Class S. Part II. Changes in Spectra of Long-Period Variable Stars.* **P. W. Merrill.** (Astrophys. J. 65. pp. 23–49, Jan., 1927.)—The author gives a list of thirty-one S-type stars, and discusses the question of lines in excess or defect of the normal, where these contain both titanium and zirconium bands. A journal and certain data concerning the individual spectrograms with the notes on individual stars are given, together with the light curves of S Urs. Maj. and R Cygni. He summarises the observations of the zirconium and titanium bands, and the hydrogen, the bright enhanced iron, miscellaneous bright lines, and the absorption lines. He concludes that S-type spectra are closely allied to giant M-type; that the temperature-range for producing zirconium bands is higher than for titanium; that the temperatures of most S-type stars' reversing layers seem near the upper limit for producing titanium bands; that the temperature-range of S-type overlaps the range of M-type, so that it is possible to distinguish the general effects of low temperature from such special effects as low density; that the great intensity of their enhanced lines, their relatively long periods, and their velocities, like those of the most tenuous M stars, all indicate the low density of S stars; that these have higher temperatures than M stars of the same density; and their relatively small velocities may indicate higher masses than those of M stars. [See also Abstract 882 (1923).] **A. S. D. M.**

corundum. The blue crystals observed in preparations of artificial ruby must be coloured by chromous oxide. The cause of the blue colour of the natural sapphire remains unknown. A. D.

LIGHT.

2007. *Influence of Temperature on Light Absorption.* **W. Nieuwenkamp.** (Zeits. f. Physik, 41. 10. pp. 787–790, 1927.)—In klinochlore the absorption maximum is flatter when warm, higher when cold. In chrome alum and cobalt sulphate these relations are reversed. A. D.

2008. *Refractive Indices of Nicotine.* **J. W. Gifford and T. M. Lowry.** (Roy. Soc., Proc. 114. pp. 592–593. April 1, 1927.)—The optical rotary power of the sample of purified nicotine employed was 205° as compared with the ideal value of 206°—a high degree of purification. The refractive indices observed at 15° C. are given in the following table :—

Wave-length.	μ.	Wave-length.	μ.
A′ 7685K_a	$1{\cdot}52061_6$	E 5270F_e	$1{\cdot}53514_8$
B′ 7065H_e	$1{\cdot}52294_9$	F 4861H_β	$1{\cdot}54035_9$
6708L_i	$1{\cdot}52452_7$	φ 4678C_d	$1{\cdot}54317_5$
C 6563H_α	$1{\cdot}52526_0$	4471H_e	$1{\cdot}54699_5$
D 5893N_a	$1{\cdot}52939_0$	4413C_{d1}	$1{\cdot}54808_0$
Λ 5608P_b	$1{\cdot}53177_9$	G 4341H_γ	$1{\cdot}54935_4$
5461H_g	$1{\cdot}53291_4$		

An accuracy of ± 1 or 2 units in the sixth figure is claimed. A. B. W.

2009. *The Colour of the Ruby.* **C. W. Stillwell.** (J. Phys. Chem. 30. pp. 1441–1466, Nov., 1926.)—*As to the Ruby.*—The red colour imparted to alpha alumina by chromic oxide is not due to colloidal chromic oxide ; it is not due to a higher or lower oxide of chromium ; it is also not due to a change in the concentration of the chromic oxide as is the case with solutions of chromium salts ; it is due to a second modification of chromic oxide, of the same crystal-structure as the green modification and alpha alumina, whose axial ratio is nearer to that of alpha alumina than is the axial ratio of the green modification.

The occurrence of the red or green modification depends on the value of the axial ratio of the mixed crystal. The two modifications differ in at least three properties : colour, axial ratio of the crystals, behaviour when exposed to kathode rays. The chromic oxide content of the natural ruby is approximately 2 %, and the cause of the colour of the natural ruby is the same as that of the artificial ruby. The temporary change of colour of the ruby to green on heating has still to be accounted for. Where there is no stabilisation of the red modification, as in the emerald, a green colour is obtained with very low concentrations of chromic oxide. *As to the Sapphire.*—Alpha alumina coloured by red chromic oxide turns bluish-red when fused in a reducing atmosphere, due to the formation of some blue chromous oxide. It remains to determine under what conditions this reduction could be carried to completion, giving a sapphire-blue corundum. The blue crystals observed in preparations of artificial ruby must be coloured by chromous oxide. The cause of the blue colour of the natural sapphire remains unknown. A. D.

2010. *Electric Double Refraction in Relation to the Polarity and Optical Anisotropy of Molecules. Part I. Gases and Vapours.* **C. V. Raman** and **K. S. Krishnan.** (Phil. Mag. 3. pp. 713–723, April, 1927. Supplement.)—An attempt is made to correlate, on the basis of Born's theory of electric double refraction, the available data on the Kerr effect of gases and vapours, with the optical anisotropy of molecules as determined from observations on light scattering, and with the polarity of the molecules as determined from dielectric constant measurements. For molecules which are electrically polar, it is found that the orientative action of an electrostatic field on the molecule is due chiefly to the couple exerted on the permanent electric doublet present, and is much larger than that with non-polar molecules. For non-polar molecules, with the simplifying assumptions of Gans regarding the relation between the constants of electric and optical anisotropy, the values of the Kerr constant can be calculated with good agreement with observed values from the depolarisation factor of the scattered light. Calculations are given for a few cases of polar molecules having an axis of optical symmetry, to which the permanent moment is parallel or is inclined at a known angle. The significance of the negative value of the Kerr constant is discussed in the light of Born's theory, with special reference to its dependence on molecular structure as evidenced in the chloromethanes. A. B. C. L.

2011. *Electric Double Refraction in Relation to the Polarity and Optical Anisotropy of Molecules. Part II. Liquids.* **C. V. Raman** and **K. S. Krishnan.** (Phil. Mag. 3. pp. 724–735, April, 1927. Supplement.)—Study of the available data of similar character to that treated in respect of gases [see preceding Abstract] is extended to the liquid state. As with vapours, it is found that all compounds exhibiting a large Kerr effect are characterised by the possession of electrically polar molecules, the influence of the polarity on the Kerr constant being more pronounced than with vapours. With non-polar molecules the moments induced in the molecules when placed in an electrostatic field are sufficient to account quantitatively for the observed double refraction. In simple cases of polar liquids like chloroform, where information is definite regarding the form of the optical ellipsoid and the position of the electric moment, the observed Kerr constant is in numerical agreement with that calculated from Born's theory, for the validity of which general support is found in all the cases examined. Measurements of the dependence on temperature of the electric double refraction of liquids support the validity of Born's expression for the Kerr constant. A. B. C. L.

2012. *Experiments on Binocular Vision.* **N. M. S. Langlands.** (Optical Soc., Trans. 28. pp. 45–78; Disc., 78–82, 1926–1927.)—A summary is given of work carried out by earlier experimenters in this branch, and the results are then described obtained from a series of measurements of binocular acuity using constant and flash illumination, both with the unaided eye and a stereoscope. Variation of the illumination, the time of exposure and the field indicated no appreciable alteration in binocular acuity when a considerable extra foveal area is illuminated with a constant illumination. A high binocular acuity may accompany a very poor sense of form, although both may improve with practice; the form sense probably resides in a higher association centre than either visual or binocular acuity. For observers without much experience and for illuminations of and under 1/25 sec., the binocular acuity is fairly poor compared with steady illuminations; for two observers tested the binocular 50 % threshold angle was roughly 30 sec.; for an illumination of 1/10 sec. it was 15 sec.; and for 1/5 sec. somewhat less. The binocular acuity varies over the fovea, decreasing from the centre. Under very favourable conditions stereoscopic relief can be produced in the binocular after-image, but in some tests the binocular acuity is determined by the illumination of the object by flash and not by the after-image. **H. H. Emsley** asked regarding the effects of fatigue and health and tests on observers who were anisometropic. R. S. R.

2013. *Contributions to the Theory of Stereoscopic Vision.* **N. M. S. Langlands.** (Optical Soc., Trans. 28. pp. 83–99; Disc., 99–103, 1926–1927.)—The author discusses the existing theories of the retinal mosaic to explain the magnitudes of visual, vernier and binocular acuities. He deals critically with the experiments and conclusions reached in these subjects by Hofmann, Heine, Fritsch, Wulfing, Hering and Helmholtz, in each of which the cone is considered as the element of visual perception. A photoelectric theory is developed to explain the phenomena observed, and a review made of existing theories of stereoscopic vision. **J. Guild** criticised the geometrical construction employed, since an image must extend over a definite area and not only over one cone, while the photoelectric changes probably occur within the body of the cone and not in the space between. **E. F. Fincham** suggested that movement of the cones during vision may alter the construction suggested. **T. Smith** raised questions regarding the relative refractive index of cone and photoelectric fluid and motion of the cones. R. S. R.

2014. *The Form of the "Punktal" Spectacle Lens.* **J. P. C. Southall.** (Optical Soc. America J. and Rev. Sci. Inst. 13. pp. 699–712, Dec., 1926.)—Investigates the best forms for a lens of given power to give point images when the eye is turned obliquely behind the spectacle lens. The thickness of the lens is taken into account. A. D.

2015. *New Type of Photographic Telescope.* **A. Couder.** (Comptes Rendus, 183. pp. 1276–1277, Dec. 20, 1926.)—The instrument described was designed with the object of photographing extended celestial objects of feeble luminosity. The problem consists in the design of an optical combination which covers a field of 3 degrees diameter with an accuracy exceeding 1 second of arc. This is achieved by the use of a particular arrangement of two concave mirrors, the photographic plate being situated between them at a distance 0·385 from the second. The field is curved, but a photographic celluloid film can be used with its surface slightly convex. The original paper should be consulted for details. A. B. W.

2016. *Theory of the Lens-Testing Interferometer. Part I.* **T. Smith.** (Optical Soc., Trans. 28. pp. 104–111; Disc., 111–113, 1926–1927.)—An interferometer is in the best adjustment when the optical images of the same part of the incident beam formed by the two reunited beams are coincident. This implies in general a difference in the optical lengths of the interfering beams from source to image. It is concluded that in the adjustments of the interferometer attention should be paid more to correspondence in optical imagery rather than to equality in the physical paths of the interfering beams. The latter becomes significant only when adjustment for image correspondence involves path differences so great that interference cannot be obtained. Neglect of this image correspondence involves more severe restrictions in the light admitted to the instrument and in other respects. Attention is directed to the importance, in the use of the camera lens interferometer, of focussing the photographic plate or the eye on the surface of the spherical mirror. In the *Discussion*, **R. Kingslake** referred to apparent zonal defects in telescope objectives tested with the simple collimator, which disappear when an achromatic collimating lens is used. R. S. R.

2017. *Examination of a Non-Spherical Concave Mirror.* **A. Couder.** (Rev. d'Optique, 6. pp. 49–55, Feb., 1927.)—By means of the Foucault knife-edge method the image of a source, placed near the centre of curvature of the mirror, is examined, and one finds if the calculated and observed aberrations coincide. For this purpose a system of lenses is employed just to correct the calculated spherical aberration, and examination of the image shows whether, and, if so, the place where, the mirror surface is faulty. Experience proves that the method is very easy to interpret and very rapid in working, so that frequent examinations may be made during the work of retouching telescope mirrors. R. S. R.

2018. *Lenouvel's Stigmatometer for Testing Microscope Objectives.* **L. Lenouvel.** (Rev. d'Optique, 6. pp. 134–139, March, 1927.)—The stigmatometer replaces the microscope eyepiece when testing the objective. Light from an illuminated iris is converged by a lens on to a graduated glass scale after reflection in a half-silvered double prism. The distance of the objective from the graduated scale is adjusted until light from the scale, after passing through the objective, reaches a silvered mirror below a cover glass and is reflected back and converged exactly on to the glass scale again. These images are viewed through the eyepiece of the stigmatometer. If the objective is uniform, the surface appears equally illuminated, but if aberrations exist this is not the case. The images seen with (1) a perfect objective, (2) a well-corrected objective with a residue of aberration, and (3) a badly-corrected objective, are shown diagrammatically and discussed. The instrument in addition can be used to find (1) the thickness of cover glass, and (2) the length of tube for a given objective and cover glass for the best image, and it can be used to test the rigidity of the frame of the microscope. R. S. R.

2019. *Determination of the Cardinal Point and Width of the Image from Photographs.* **V. Theimer.** (Zeits. Instrumentenk. 47. pp. 134–145, March, 1927.)—The author shows how the position of the cardinal point and magnitude of the image can be derived from a photograph when the photographic plate is inclined at any given angle with respect to the direction of observation. The paper is entirely one of analytical geometry, and should be consulted in its entirely. H. H. Ho.

2020. *Portable Tachymeter of 9 cm. Circular Diameter Made by F. W. Breithaupt & Son.* **W. Uhink.** (Zeits. Instrumentenk. 47. pp. 146–148, March, 1927.)—This note describes in detail an accurate instrument of total height 185 mm. and weight 3·5 kg., which is very suitable for measurements to be taken on railways, ships, in the forest, or on mountains. H. H. Ho.

2021. *Polarisation of Canal-Ray Light.* **E. Rupp.** (Phys. Zeits. 27. pp. 796–798; Disc., 798, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Extends the work of Stark and Lunelund on hydrogen to hydrogen, helium and lithium. The atoms in the canal rays seem to become luminous on impact with irregularly arranged molecules or with free electrons; it is not yet clear which. A. D.

2022. *Polarisation in Shock-Light.* **B. Quarder.** (Zeits. f. Physik, 41. 8–9. pp. 674–687, 1927.)—The polarisation in mercury luminescence is examined throughout a large range of velocities. Between 16 volts and 15,000 volts the direction and the amount of the polarisation depend on the velocity of the impinging electrons. Most of the mercury lines are polarised parallel, and fall off exponentially with increasing electron velocity; a few lines are polarised at right angles, or are not polarised at all. The theory is discussed. A. D.

2023. *Spectral Distribution of Polarisation in Scattering of Light by Turbid Media.* **G. I. Pokrowski.** (Zeits. f. Physik, 41. 8–9. pp. 688–694, 1927.)—The peculiarities of this are studied with reference to Mie's theory [see Abstract 594 (1908)], particularly with regard to the light of the sky; they depend on the size of the particles. If these be small enough, the polarisation is the same for all wave-lengths; with larger particles the polarisation tends to increase more for the greater wave-lengths. Observation agrees with theory. A. D.

2024. *Molecular Scattering of Light in a Binary Liquid Mixture.* **K. C. Kar.** (Phil. Mag. 3. pp. 601–604, March, 1927.)—Raman and Ramanathan [see Abstract 893 (1923)] have attempted to improve Einstein's equation for molecular scattering of light in a binary liquid mixture. The object of the present paper is to show that the additional improvement term obtained by them is wrong, and that the corrected term is vanishingly small, so that Einstein's equation holds good. J. J. S.

2025. *Measurements of the Velocity of Light between Mt. Wilson and Mt. San Antonio.* **A. A. Michelson** and **W. Bowie.** (Mt. Wilson Observat. Contrib. No. 329. Astrophys. J. 65. pp. 1–22, Jan., 1927.)—Readings were obtained in July, 1925, and June–September, 1926, with the glass octagon used earlier [see Abstract 524 (1925)], and these gave a velocity *in vacuo* of 299,797 km./sec. Next measurements were made with four other mirrors and with various improvements in the experimental details. The velocities obtained with these mirrors are

(1)	Ni steel, 8 facets ..	299,795 km./sec.
(2)	Glass, 12 facets ..	299,796 km./sec.
(3)	Ni steel, 12 facets ..	299,796 km./sec.
(4)	Glass, 16 facets ..	299,796 km./sec.

It was intended in December, 1926, to extend the measurements to a distance of 82 miles between Mt. Wilson and Mt. San Jacinto. In an

Appendix **W. Bowie** gives full details of the extended series of measurements made to determine the exact air distance between Mt. Wilson and Mt. San Antonio. Elaborate precautions were taken to eliminate sources of error and an accuracy of 1 part in $6 \cdot 8 \times 10^6$ is claimed for the distance measured, a higher degree of accuracy than any previously obtained in triangulation in the U.S.A., or elsewhere in the world. R. S. R.

2026. *Photographic Inversion by Heat.* **H. Belliot.** (Comptes Rendus, 183. pp. 1279–1280, Dec. 20, 1926.)—Allen (Photoelectricity, p. 209) has shown that it is possible to produce a partial disappearance of the latent photographic image by heating the exposed plate for a sufficient length of time at a particular temperature (three days near 50° C.). The author refers in the present paper to similar experiments using red and infra-red radiation [see also Abstract 2590 (1926)]. It is shown that the effects described by Allen can be produced in eight hours by heating to 95–100° C. (using P_2O_5 to absorb moisture and prevent melting of the gelatine). A. B. W.

2027. *Measurement of the Brightness of the Day Sky. Distribution of Light Over the Sky.* **J. Peyre.** (Rev. d'Optique, 6. pp. 73–80, Feb., 1927.)—Details are given of a photometric method which, after a standardisation of the apparatus by a process of heterochrome photometry, permits a direct measurement to be made of the brightness of the sky at any given point. A rapid series of measurements was carried out on several days in a clear sky at Montpellier for different azimuths and elevations. The regions of minimum brightness were found and a series of curves drawn for points of equal brightness for different elevations of the sun. R. S. R.

2028. *Relation between Time and Intensity in Photographic Exposure.* **L. A. Jones, V. C. Hall** and **R. M. Briggs.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 223–232, March, 1927.)—In connection with the known failure of the reciprocity law relating the effects of time and intensity in photographic exposure [see Abstract 1812 (1926)] attention is drawn to the possible influence of the developing agent and the extent of development upon the magnitude of the divergence from the reciprocity law, and results of experiments bearing on this phase of the subject are reported. From a study of a large number of emulsions of different types it is concluded that there is no silver bromide or bromo-iodide emulsion for which the curves of constant density in the region of optimal intensity may not be represented by the Kron-Halm equation $It = \frac{1}{2}I_0t_0/[(I/I_0)^a + (I/I_0)^{-a}]$. Several emulsions are found having optimal intensity so high that no resemblance to the curve represented by the above equation can be reached by intensities as high as sunlight, but in all cases where optimal intensity is reached or exceeded the catenary type appears superior to the hyperbola preferred by Kron. No reason for the discrepancies in results obtained by different workers is found in a study of different developing agents. The results of the work on the extent of development, checking previous data on the subject, show that the major effect of extending time of development is to shift optimal intensity to a higher value. A. B. C. L.

2029. *Compensation of Distortion in Objectives for Aeroplane Photography.* **I. C. Gardner** and **A. H. Bennett.** (Optical Soc. America,

J. and Rev. Sci. Inst. 14. pp. 245–250, March, 1927.)—It is remarked that lenses to be used for topographic surveying by aeroplane photography must be substantially free from distortion, and that it is difficult to obtain objectives satisfactorily in this respect. It is shown that in many cases the distortion can be compensated by a plane parallel plate used as an additional component of the lens. The effect of the plane parallel plate is generally not detrimental to the correction of the other aberrations of the objective. Experimental work justifying these conclusions is reported.

A. B. C. L.

2030. *Silver Sulphide Sensitising by Bathing.* **S. E. Sheppard** and **E. P. Wightman.** (Eastman Kodak Co., Research Lab. Comm. No. 299, Phot. J. 67. pp. 219–226, May, 1927.)—It is shown by using photographic plates thinly coated with dilute emulsion prepared without a sensitiser that it is possible to study certain phases of the sensitising process and to obtain results in agreement with those previously obtained by sensitising the emulsion in the fluid state. Two methods of treating the plates are employed. It is found that with increasing concentration of sensitiser the sensitivity increases to a maximum. This accords with previous results. There is possibly an appreciable extension of the spectral sensitivity by sulphide sensitising. This is not in entire agreement with previous results, and will have to be checked by further work. The presence of optical sensitisers is suspected. With variation of the hydrogen-ion concentration of the allylthiocarbamide sensitising solution in a two-stage sensitising procedure from a *p*H of 2 to *p*H of 4 the degree of sensitising is about equal. While sensitising at a *p*H of 5 appears to give greater increase in speed, it may be merely due to a large increase in fog. Silver bromides are found to decrease the amount of sensitising, and sensitising after desensitising causes the production of a marked amount of fog. The possible causes underlying some of these facts are discussed in some detail, particularly the existence of a maximum in sensitising which is ascribed to an ionic lattice strain and ionic deformation, together with a competition among the sensitive specks for the silver produced photochemically. It is pointed out, however, that the present work cannot allow of a decision between this concentration-speck theory and the halogen-acceptor theory of Hickman. [See also Abstract 104 (1927).]

A. E. G.

2031. *Gloss Measurement.* **A. Klughardt.** (Zeits. techn. Physik, 8. 3. pp. 109–119, 1927.)—Describes measurements of the reflection characteristics of diffusing materials by a modification of the method proposed by W. Ostwald using Pulfrich's comparator [see Abstract 1626 (1925)]. The direction of incidence of the light and the direction of view are always inclined at 45° to each other, and the material under observation is tilted so that the angle of view varies from 0° to 90° in the quadrant opposite to that containing the angle of incidence. Under these conditions, the brightness of a perfect diffuser is $K \sin (45° + \delta)$, where K is a constant and δ is the angle of view. It is proposed that the gloss of a surface should be expressed fully by the curve connecting δ with the difference between the observed brightness and that given by the above formula. Results of measurements on various matt grey papers and on a matt surface of a barium sulphate in gelatine emulsion are given. For the latter surface, the departure from perfect diffusion was less than 0·1

(7 %) for all values of δ less than about 75°, and was zero at 45° (normal incidence). For an abbreviated description of the gloss characteristics, the value of the departure from perfect diffusion when $\delta = 10°$ and the value of δ at which this departure is zero may be used. J. W. T. W.

2032. *Effects of Dilution and Stirring a Photographic Developer.* **A. H. Nietz** and **R. A. Whitaker.** (Eastman Kodak Co. Research Lab. Com. No. 288. Frank. Inst., J. 203. pp. 509–535, April, 1927.)—The relationship between the time of development and concentration of developer does not follow the simple law $C \cdot T_{dev.} = K$, where C is the concentration of the developer and K is a constant. There is, in general, a maximum density of film produced at a definite concentration of developer, the density falling off with both increasing and decreasing concentration. The form of the density-concentration curves is explained by (1) hydrolysis, which removes some of the active phenolate anion; (2) the imperfect outward diffusion of bromide and other reaction products from the emulsion—efficient stirring eliminates this effect and gives increasing density with dilute solutions; (3) aerial oxidation, which partially accounts for a decrease in density with more dilute solutions, markedly so for developers which rapidly oxidise—the effect of this factor is increased by stirring; and (4) the difficulty of penetration into the emulsion and tanning, more especially with concentrated solutions. L. M. C.

2033. *Use of Coloured Screens in Heterochrome Photometry.* **R. Jouaust** and **P. Waguet.** (Rev. d'Optique, 6. pp. 59–67, Feb., 1927.)—Carbon filament lamps are taken as a standard. Practically the only lamps now in use are those with tungsten filaments. In comparing them with the standards we are faced with the problem of heterochrome photometry, which still awaits a satisfactory solution. The authors claim that their solution is, if not perfect, at least sufficient for practical purposes. It consists in replacing the comparison in heterochrome light with one in light which is approximately monochromatic by interposing a coloured screen between the eye and the photometer. The screen should satisfy two conditions: (1) Its use should eliminate the discrepancies existing between observers employing the ordinary methods; (2) it should give results in close agreement with the mean results obtained in heterochrome light by a certain number of operators. A screen formed of a solution consisting of potassium bichromate and copper chloride in suitable proportions appears to possess the requisite qualities. E. F.

2034. *Photographic Spectrophotometry in the Red and Infra-Red.* **A. L. Schoen.** (Eastman Kodak Co. Research Lab. Com. No. 293. Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 179–186, Feb., 1927.)—Plates sensitised with neocyanine are sensitive to 900 $m\mu$, and when hypersensitised to 1000 $m\mu$; they also keep well. The method here outlined employs these plates, and a Sperry 12-in. submarine type "D" high-intensity arc (110-volt, 35 amperes) to give sufficient illumination for the high dispersion necessary. The polarisation spectrophotometer is used in the usual way. Examples are given. A. C. M.

2035. *The Grey Wedge Photometer.* **A. Hnatek.** (Zeits. wiss. Phot. 24. pp. 310–315, March, 1927.)—Results of experimental work with grey wedge photometers are described; among them the following are specially recorded: The wedge constant is throughout essentially smaller than 0·40137; all sorts of plates do not have the same value for the wedge constant, and to all appearances the colour of the light source plays also some part; the wedge constant is larger with less blackening, and greater wedge constants are as a rule given by measurements with hole-blackening than by measurements in the sensitometer wedge. A. E. G.

2036. *Colour and Light Sensitivity of Silver Sols.* **E. Wiegel.** (Zeits. wiss. Phot. 24. pp. 316–325, March, 1927.)—The following are the chief points here considered: The slow coagulation of the dextrin silver sol, the light sensitivity of the dextrin silver sol, spectral-photometric measurements, the control colours of the dextrin silver sol. A. E. G.

2037. *Modified F.R.B. Photometer Working with Constant Illumination of Field.* **W. B. Ferguson.** (Phot. J. 67. pp. 136–138; Disc., 138–139, March, 1927.)—The objects aimed at in the new design comprised the measurements of densities with a field of constant illumination, reduction of errors due to the many reflections in the F.R.B. pattern, and a more exact method of setting the zero. Details are given of the main variations from the original F.R.B. design, and photographic reproductions illustrate the details of the new instrument. Its method of use is explained. Multiplication of the readings by the factor 0·96 reduced them to the standard photographic contact density value $D\phi$ of the British Photographic Research Association. R. S. R.

2038. *Application of Copper Salts in the Carbro Process.* **F. J. Tritton.** (Phot. J. 67. pp. 140–144; Disc., 144–145, March, 1927.)—In the ordinary carbro process, when conducted in a single bath, K_3FeCN_6 tends to decompose and Cu salts are used to obviate this difficulty. In the theoretical section of the paper details are given of the probable chemical changes during the various stages of the process and the functions of the different salts used in the baths. A summary is also given of the conditions for obtaining a satisfactory carbro print when using a Cu bleaching bath. The second section of the paper contains information relating to practical difficulties in the working of the process. In the *Discussion*, **Greenwood** suggested the films being used as permeable membranes in order to trace a little more closely some of the diffusion phenomena. R. S. R.

2039. *The Excitation of Fluorescence in Fluorescein.* **E. H. Kennard.** (Phys. Rev. 29. pp. 466–477, March, 1927.)—Fluorescence in violation of Stokes' law, excited in an alcoholic solution of specially purified fluorescein, was compared by a photoelectric method with the reciprocal emission when fluorescent and exciting wave-lengths are interchanged. The following theoretical equation, recently proposed by the author [see Abstract 736 (1927)], was found to be largely verified: $f_{yx}/f_{xy} = \lambda_x J_y/\lambda_y J_x$. Here f is the exciting power, *i.e.*, $f_{yx}d\lambda_y$ is the emission of fluorescent energy from unit volume in the wave-length range $d\lambda_y$ when the fluorescing substance is illuminated with unit density of exciting radiation of wave-length λ_x, f_{xy} is the same thing with the wave-lengths interchanged, and J_x, J_y are the densities of black-body radiation for these two wave-lengths at the temperature of the fluorescing substance. A peculiar interest attaches to this equation because it contains no unknown constants. Fluorescence, excitation and absorption curves for the same fluorescein were also determined with moderate accuracy. The fluorescence curves show a single maximum around 5240 Å., but change shape as the exciting wave-length is varied. The excitation curve for fixed incident energy shows a maximum around 5000 for fluorescence at 5270; for other points in the fluorescence spectrum the maximum excitation occurs at shorter wave-lengths, *e.g.*, at 4730 ± 80 Å. for fluorescence at 5009 or 5582. The curves suggest two superposed bands of different width but with almost coincident peaks. The maximum absorption occurs around 4750. AUTHOR.

2040. *New Study of Certain Radiations from Mercury, Krypton and Xenon with a View to their Metrological Application.* **A. Pérard.** (Comptes Rendus, 184. pp. 681–683, March 14, 1927.)—The results are given of an analysis of the possible use for exact wave-lengths of the following: (1) for Hg, 4358, 4916, 5461, 5770 and 5791 Å.; (2) for Kr, 5570 and 5871 Å.; and (3) for X, 4624, 4671 and 4734 Å. A Cooper-Hewitt lamp was used in the tests for Hg, while for Kr and X the same method was used as for He. [See Abstract 1340 (1927).] R. S. R.

2041. *Emission of Short Wave-Length Radiations by Feebly Conducting Bodies.* **E. Bodin.** (Ann. de Physique, 7. pp. 35–102, Jan.–Feb., 1927.)—The paper commences with a review of the work of Reboul [see Abstract 2266 (1922)] on this subject. The work now described involves a study of the variations of the mean absorption coefficients of these radiations in air at ordinary pressure. The observations lead to the conclusion that the radiation is complex, and that its mean penetrating power increases with time and with the voltage applied to the feebly conducting substance. The investigation has been extended to other substances capable of emitting the radiation. The current intensity through the substance diminishes with time, and does not obey Ohm's law. The study of the distribution of potential in the material indicates a large potential drop at the electrodes. A. B. W.

2042. *Quantum Theory of Emission and Absorption of Radiation.* **P. A. M. Dirac.** (Roy. Soc., Proc. 114. pp. 243–265, March 1, 1927.)—A mathematical paper. The problem is treated of an assembly of systems satisfying the Einstein-Bose statistical mechanics, which interact with another different system, a Hamiltonian function being obtained to describe the motion. The theory is applied to the interaction of an assembly of light-quanta with an ordinary atom, and it is shown that it gives Einstein's laws for the emission and absorption of radiation. The interaction of an atom with electromagnetic waves is then considered, and it is shown that, if one takes the energies and phases of the waves to be q-numbers satisfying the proper quantum conditions instead of c-numbers, the Hamiltonian function takes the same form as in the light-quantum treatment. The theory leads to the correct expressions for Einstein's A's and B's. A. B. W.

2043. *Electric-Furnace Spectra of Yttrium, Zirconium and Lanthanum.* **A. S. King** and **Edna Carter.** (Mt. Wilson Observat. Contrib. No. 236. Astrophys. J. 65. pp. 86–107, March, 1927.)—Furnace spectra of yttrium, λ2808–λ7882; zirconium, λ2792–λ8305; lanthanum, λ2799–λ8347.—Temperature stages from 2000° to 2800° C. were employed to observe the initial appearance of lines and their rate of increase in intensity, supplemented by low-temperature absorption spectra in the ultra-violet. A direct comparison with arc and spark spectra showed the changes undergone in these sources and served to select the enhanced lines. The numbers of lines classified are 451 of yttrium, 858 of zirconium, and 695 of lanthanum. Many enhanced lines of yttrium and lanthanum, and some of those of zirconium, are emitted by the furnace, their intensities in furnace and arc indicating the relative energy-levels of the ionised atom. For zirconium a temperature of about 2400° was required before any considerable number of lines appeared, and for this element a large proportion of lines emitted by the arc are enhanced lines. In the lanthanum spectrum note is made of the large number of close doublets, and some triplets, all of which have been previously listed as single lines ; also of the large proportion of lines relatively stronger in the furnace than in the arc. AUTHORS.

2044. *Structure of the O III Spectrum.* **C. Mihul.** (Comptes Rendus, 184. pp. 89–91, Jan. 10, 1927.)—Measurements of the Zeeman effect have enabled four more triplets and four quintuplets to be found in this spectrum [see Abstract 1029 (1927)]. Details of these multiplets are given. F. S.

2045. *Third Order Spectrum of Oxygen.* **C. Mihul.** (Comptes Rendus, 184. pp. 874–878, April 4, 1927.)—In two earlier papers [see Abstract 1029 (1927) and preceding Abstract] the author has given a description of four multiplets of multiplicity ($r = 5$), and nine multiplets of multiplicity ($r = 3$), relating to the third order spectrum of oxygen (O III). Further observations, of which details are given in the present note, show in this spectrum five new multiplets of the system of triplets ($r = 3$). A. B. W.

2046. *Continuous Hydrogen Spectrum.* **O. Oldenberg.** (Zeits. f. Physik, 41. 1. pp. 1–7, 1927.)—The continuous spectrum, which stretches from about 1450 Å.U. to over 5000 Å.U., behaves as a whole under various conditions (variations of pressure, pressure of admixed gases, current density, magnetic field). It must therefore all be due to the same elementary process. A minimum of intensity about 4000 Å.U. observed in canal rays is ascribed to the proximity of the head of the Balmer series. A. C. M.

2047. *Intensity Asymmetry in the Hydrogen Stark Effect.* **R. Wierl.** (Ann. d. Physik, 82. 4. pp. 563–575, Feb. 26, 1927.)—In the Stark effect in hydrogen the long-wave component is stronger than the short-wave, or *vice versa* according to the field direction. This asymmetry of intensity is shown to be present in the case of stationary molecules stimulated by nitrogen canal rays as well as in the more ordinary case of moving hydrogen. For both field directions the effect is opposite for the resting particles compared with the moving ones. This is ascribed to an orientation in the atom with respect to the field vector. "Pure" hydrogen rays have symmetrical intensities ; even if by passing through an electric field in nitrogen asymmetry is shown, after passing on into a high-vacuum region, symmetry once more obtains. So the disymmetry usually shown must be put down to the interaction with foreign gases. A. C. M.

2048. *Intensity Asymmetry in the Hydrogen Stark Effect.* **F. G. Slack.** (Ann. d. Physik, 82. 4. pp. 576–584, Feb. 26, 1927.)—If the electric field is in the direction of motion of the hydrogen atoms, the long-wave component is stronger, and *vice versa.* This has been explained qualitatively by Bohr [see Abstract **1437** (1915)] and quantitatively by Sommerfeld. When the motion and field directions are the same, the long-wave orbits are more behind the nucleus ("behind" in the sense of the field), and when the motion and field directions are opposed, the long-wave orbits are more in front of the nucleus. If the rays now pass through the rarefied gas in the tube, the orbits "behind" the nucleus are more protected from the gas particles, so that they are greater in number than the orbits "in front of" the nucleus. Wierl's observations [see preceding Abstract] are in agreement with the Bohr theory, when we consider the relative motion of the nitrogen canal rays and the stationary hydrogen atoms from the point of view of the direction of impact on the hydrogen atoms. In the present paper these phenomena are explained on the basis of Schrödinger's mechanics. A. C. M.

2049. *Bands in the Secondary Spectrum of Hydrogen.* **H. S. Allen** and **I. Sandeman.** (Roy. Soc., Proc. 114. pp. 293–312, March 1, 1927.)—In a recent paper by Sandeman [see Abstract **1333** (1926)] on the secondary spectrum of hydrogen at higher pressures a band has been described comprising a P, Q and R combination, and attributed to triatomic hydrogen. This has since been found to be one of a very considerable system of bands. These bands occur in groups, the bands of a group being spaced out at intervals of very nearly 92 wave-numbers, the spacing being in some cases approximately constant and in others conforming to a quadratic law. The bands are found both in the range of wave-lengths measured by Merton and Barratt and by Tanaka, and also in the infra-red region recently investigated by Allibone. Two groups occurring in the latter region have been considered in detail. Experiment has shown that in some cases the lines of the groups are enhanced in the spectrum of the arc of hydrogen at higher pressures. The bands must originate in molecules with large moments of inertia, and other reasons are also advanced for believing that they are due to active or triatomic hydrogen. A complete analysis of their structure would prove an important step in understanding triatomic spectra. A. B. W.

2050. *Nitrogen Absorption Bands.* **H. Sponer.** (Zeits. f. Physik, 41. 8–9. pp. 611–615, 1927. Nat. Acad. Sci., Proc. 13. pp. 100–104, March, 1927.)—These were observed in the Lyman region by filling a vacuum-grating spectrograph with nitrogen under various pressures, and using the discharge of a large capacity (0·5 μF) through a capillary discharge tube to provide the continuous spectrum. The bands found by Lyman, Birge, and Hopfield in nitrogen, which were ascribed by the author to NO on account of the agreement of the frequency differences, are now shown to belong to nitrogen. On the other hand, the absorbtion system which should go with the known nitrogen bands cannot be found. A. C. M.

2051. *Electronic States in Diatomic Molecules. Part III. Intensity Relations.* **R. S. Mulliken.** (Phys. Rev. 29. pp. 391–412, March, 1927.)—Intensity relations for P, Q and R band-lines in molecules with a rotational energy term $B(j^2 - \sigma^2) + \ldots$ can be deduced from the correspondence principle. This is here done, using the summation rules, and the equations are recast in a new form. Various emission bands have earlier been attributed by the author to typical electronic transitions, *e.g.*, ${}^1S \rightarrow {}^1S$ (CuH type), ${}^1S \rightarrow {}^1P$ (CO Å. bands), etc. The intensities as predicted by the above theory are in qualitative agreement with the available intensity data. The agreement seems to make conclusive the evidence for interpreting electronic bands as due to transitions between ${}^1S$, ${}^1P$, ${}^1D$ molecular states, which all belong to a class in which σ is an electronic quantum number correlated with a precession about the internuclear axis. [See also Abstract 1386 (1927).] A. C. M.

2052. *Transformation Spectra.* **E. L. Nichols, H. L. Howes** and **D. T. Wilber.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 205–222, March, 1927.)—The paper consists of a study of the colour and appearance of various molten beads when subjected to temperature changes, particularly when the beads contained traces of metallic elements; and also a study of the spectral changes associated with the above when the elements introduced were rare earths. As a result, Lenard's observations on molten beads were confirmed and the temperatures determined. Thirty-seven elements whose salts cannot be readily obtained in molten bead form were introduced into beads of sodium phosphate or of borax. When heated in a hydrogen flame, transformations were noticed characterised by sudden clouding, or clearing, of the bead, and often by marked changes of brightness or transient changes of colour. These effects were reversible. The spectra are continuous or broad-banded, except in the cases of erbium or neodymium, when the well-known emission bands appear. When a rare-earth element is involved, the spectrum at transformation is a narrow-banded one, corresponding to the narrow kathodo-fluorescent bands. A. C. M.

2053. *Fluorescence Spectra of the Sulphur Group.* **J. C. McLennan, I. Walerstein** and **H. G. Smith.** (Phil. Mag. 3. pp. 390–395, Feb., 1927.)—New fluorescence spectra have been found in the vapours of sulphur, selenium and tellurium, excited by intense illumination with a quartz mercury arc. These are found with saturated vapours at comparatively low temperatures, and are apparently quite different from the fluorescence spectra found for these elements by Diestelmeier [see Abstract 438 (1916)] and others. In the case of selenium two distinct spectra have been found at different temperatures. A fluorescence spectrum has also been found for bismuth vapour under similar circumstances. J. E.

2054. *Arc Spectrum of Lead.* **N. K. Sur.** (Phil. Mag. 3. pp. 736–739, April, 1927. Supplement.)—It is pointed out that previous investigations of the arc spectrum of Pb, including the determination of the values of all fundamental and other terms as well as several Rydberg series, do not suffice for a complete explanation from the standpoint of Hund's theory of complex spectra. An application of Hund's theory to the structure diagram of Pb, written according to Saha's method, is developed and discussed, rendering the situation clearer and confirming the frequent occurrence of Rydberg sequence of the displaced type, and of forbidden transitions, in the spectra of heavy elements. A. B. C. L.

2055. *L-Emission Spectra of Lead and Bismuth.* **C. E. Eddy** and **A. H. Turner.** (Roy. Soc., Proc. 114. pp. 605–610, April, 1927.)—In a previous paper the authors have dealt with the L-emission series of mercury [see Abstract 2109 (1926)]. The present paper gives a brief account of similar work with lead and bismuth. The results are given in tabulated form. A. B. W.

2056. *Absorption Spectra of Nickel, Cobalt and Tellurium.* **J. C. McLennan** and **R. F. B. Cooley.** (Roy. Soc. Canada, Trans. 20. 2. pp. 349–353, 1926.)—The absorption spectra of these metals in the ultra-violet down to 1450 Å.U. was observed using a carbon-tube furnace, and the fluorite spectrograph described in connection with an earlier investigation [see Abstract 258 (1921)]. The lines absorbed are listed. A. C. M.

2057. *Arc Spectrum of Germanium and a Note on Carbon.* **J. C. McLennan** and **A. B. McLay.** (Roy. Soc. Canada, Trans. 20. 2. pp. 355–363, 1926.)—The elements of the fourth column of the periodic table should have similar spectra. Si, Sn, Pb have been already shown to have similar spectra. C and Ge are now considered ; the germanium arc spectrum is in agreement with the requirements of the Heisenberg-Hund theory, and as far as now investigated carbon also falls into line. A. C. M.

2058. *Absorption Spectra of Some Metallic Vapours.* **J. C. McLennan, Elizabeth Cohen** and **M. J. Liggett.** (Roy. Soc. Canada, Trans. 20. 2. pp. 365–376, 1926.)—An investigation of the vapours of manganese, nickel, palladium, platinum, cerium, lanthanum, neodymium, praseodymium, thorium, and uranium. The regions were varied, but lay between 6000 Å.U. and 1450 Å.U. For metals easily vaporised, and where short columns of vapour were sufficient, a small carbon tube furnace heated by an arc was used. For less easily vaporised metals or for longer columns the furnace was of the horizontal tube type. The lines found to be selectively absorbed are listed. A. C. M.

2059. *Spectra of Doubly Ionised Gallium and Indium.* **K. R. Rao.** (Phys. Soc., Proc. 39. pp. 150–1 60, Feb. 15,1927.)—The spark spectra of these two elements were studied in hydrogen, in air, and *in vacuo*, varying the discharge by means of induction, capacity, and by changing the pressure of hydrogen in the spark-chamber. The regularities in the spectra of GaIII and InIII so found are compared with those of the spectra of homologous electronic structures (CuI, ZnII, and AgI, CdII respectively). A. C. M.

2060. *Spectrum of Ionised Tin (SnIII).* **K. R. Rao.** (Phys. Soc., Proc. 39. pp. 161–168, Feb. 15, 1927.)—To help in the detection of series in InII, attempts have been made to find regularities in SnIII. Various observations of the spark (in air, in hydrogen, and *in vacuo*) revealed a strong triplet about λ5100. Two more triplets were then found which confirmed this. Other possible relationships are pointed out. A. C. M.

2061. *Absorption Spectra of Five-Membered Heterocylic Compounds.* **S. Menczel.** (Zeits. phys. Chem. 125. pp. 161–210, Feb., 1927.)—This paper contains the experimental results only of work on thiophene, furane, pyrrhol, and derivations of these (furanemonocarbonic acid, furfurylalcohol and furfurol), and on indol, fluorene, carbazol, isatin, rhodanin, and on anhydrides (pthalic acid anhydride, bernstein acid anhydride, and maleïc acid anhydride). The results are too detailed for abstraction ; the theoretical work will appear later in a paper by V. Henri. A. C. M

2062. *Intensity Variations in a Mercury Triplet.* **S. Eskeland,** with a note by **L. Vegard.** (Phys. Zeits. 28. pp. 89–93, Jan. 15, 1927.)—The problem was to find if the intensities of the lines of the triplet $2p_{1,2,3} - 2S$ were affected by variations in voltage or vapour pressure. The intensities are a measure of the relative probability of transition from the one 2S orbit to the three $2p$ orbits. It is found that the relative intensities are affected by vapour pressure. Thus the probability of transition to the three orbits is not an inner property of the atom alone. It may be that the experiment is upset by change in the vapour density changing also the absorption in the passage of the light through the vapour in the tube itself, so bringing about a spurious change in the relative intensity. This point is being investigated. A. C. M.

2063. *Spark Spectrum of Copper* (*CuII*). **A. G. Shenstone.** (Phys. Rev. 29. pp. 380–390, March, 1927.)—The spark spectrum of copper consists of (1) a low set of terms, ^3D and ^1D, from the structure (d^9s); (2) an intermediate set, $^3P, ^3D', ^3F, ^1P, ^1D', ^1F(d^9p)$; (3) a high set, $^3D, ^1D\ (d^9, s)$; (4) probably a $^1S(d^{10})$, the lowest term and giving combinations outside the observed range. All of these terms except ^1S have been identified by intensities of combinations and by Zeeman effects. They are all inverted except ^3F, which is only partially so, and the interval rule does not hold. The terms $^3D_3'$ and $^1F_3$ apparently share their g-sum and are otherwise not differentiable. The value of ^1S can be found from arc spectrum limits to be about 22224 wave numbers lower than $^3D_3$. The application of the combination principle makes possible the calculation of accurate wave numbers in the ultra-violet to λ1944. A comparison is made with corresponding terms in NiI and PdI, and it is shown that the limits of the component term series in all three cases apparently do not agree with Hund's predictions. It is important that the difference $^3D_3 - ^3D_1$ in the three spectra is constant within the series to less than 1/10 %, in the case of CuII, being apparently absolutely constant and equal to the difference $^4D_4 - ^4D_1$ of the arc spectrum. An ionisation potential for CuII is calculated as about 20·5 volts. [See Abstract 380 (1927).] AUTHOR.

2064. *Auroral Green Line* λ5577 Å. **J. C. McLennan, J. H. McLeod** and **W. C. McQuarrie.** (Roy. Soc., Proc. 114. pp. 1–22, Feb. 1, 1927.)—The green line, λ5577·35 Å., occurs in *pure* oxygen and with greatest intensity when the oxygen is at a pressure equivalent to 2 mm. Hg. At this pressure in a discharge tube the intensity of the line increases with the current strength. It appears with increased intensity when either helium, neon, or especially argon, is mixed with the oxygen. The Zeeman effect of the green line from longitudinal observations gives a clear doublet with a separation equal to that of the outer components of a normal triplet. Considerations are given in favour of the view that the line originates in an electronic transition between two singlet spectral terms that are included in one or other of two new schemes of single-triplet terms that have been shown to be possible for oxygen in addition to the ordinary well-known triplet-quintet scheme. W. H. GE.

2065. *Chemiluminescence of Sodium Vapour.* **R. L. Hasche, M. Polányi** and **E. Vogt.** (Zeits. f. Physik, 41. 8–9. pp. 583–610, 1927.)—The intensity distribution in the D-lines of sodium was investigated, The line-width can be determined to a few thousandths of an Å.U. by the absorption of the D-lines in sodium vapour if the line is itself narrow. The luminescence of the highly rarefied flame from sodium and $HgCl_2$ gave a varying half-width of 0·055 to 0·08 Å.U., according to the sodium-vapour density. This dependence on density is ascribed to self-absorption, which leads to re-emission. The energy for the excitation of the luminescence comes partly from the oscillation-energy of the sodium-chloride molecule. Energy considerations show that the sodium-atom emits while free. A. C. M.

2066. *Flash Arc Spectrum of Sodium.* **F. H. Newman.** (Phil. Mag. 3. pp. 364–368, Feb., 1927.)—In previous work on the flash arc spectrum of potassium it has been shown experimentally that the spark lines are intensified in this type of arc, and in the present investigations similar experiments on the flash arc spectrum of sodium are made. The discharge tube used contains three electrodes. The two between which the arc is struck are encased in a glass tube and has metallic sodium packed round the ends of the iron, so that a sodium arc can be produced. A momentary electrical discharge from an induction coil can be passed between the third electrode and one of the arc electrodes, and by means of a rotary commutator the arc, once struck, can be rapidly quenched and started alternately. The difference between the ordinary and intermittent arc spectra is shown. It is to be expected, from considerations stated, that the spark lines of sodium would fall into two divisions with a certain amount of overlapping. The first division, corresponding to the neon red spectrum, is excited with a low stimulus, and this is the spectrum produced in the present work. A. E. G.

2067. *Band Fluorescence of Mercury Vapour.* **F. G. Houtermans.** (Zeits. f. Physik, 41. 2–3. pp. 140–154, 1927.)—It is known that, besides a line spectrum, mercury vapour possesses a series of bands, some of them unresolvable [see also Abstract 1896 (1925)]. This work is concerned with this band spectrum. Fluorescence was excited with Hg line 2537 Å. There is a difference in the decay time for different parts of the spectrum. As emitters are assumed two excited states of the Hg molecule in the neighbourhood of 2^3P_1 and 2^3P. The long-wave maxima at 3300 and 4850 are attributed to the breaking down of the excited molecule. After the conclusion of this paper a note from Raleigh appeared in *Nature* [see Abstract 2378 (1926)]. His results are in conformity with the scheme suggested here. J. E.

2068. *Duration of the After-Luminosity of Mercury Vapour.* **Maria Asterblum.** (Zeits. f. Physik, 41. 4–5. pp. 294–300, 1927.)—Previous work on this subject is first discussed [see Abstract 897 (1919)]. Experiments are then described in which the after-luminosity of mercury has been observed in a moving current of vapour outside the discharge zone. The velocity of the vapour current was 75 m./sec. By means of photometric methods five spectral lines were determined on the spectrograph of the after-effect. The curve of decline was found to be an exponential one and the period for the above lines to lie between $1{\cdot}1 \times 10^{-4} - 7{\cdot}7 \times 10^{-5}$ sec. H. H. Ho.

2069. *The Arc Spectrum of Tin.* **N. K. Sur.** (Zeits. f. Physik, 41. 10. pp. 791–793, 1927.)—The paper attempts to explain the data obtained by Zumstein [see Abstract 1352 (1926)] in terms of Hund's theory [see Abstract 89 (1926)]. **W. V. M.**

2070. *Absorption of X-Rays from* $\lambda = 0 \cdot 08$ *to* $4 \cdot 0$ *Å.U.* **S. J. M. Allen.** (Phys. Rev. 28. pp. 907–922, Nov., 1926.)—The mass-absorption coefficients of a number of elements from C to U for homogeneous X-rays ($\lambda = 0 \cdot 709$ to $1 \cdot 933$ Å.U.) have been measured. Combined with previous observations by the author [see Abstract 1591 (1926)] the present results give a series of absorption coefficients from $\lambda = 0 \cdot 08$ to $\lambda = 4$ Å.U. Over the complete range of wave-lengths the absorption coefficient of Al appears to be accurately represented by the formula $\mu/\rho = (13 \cdot 9 \text{ or } 14 \cdot 0)\lambda^{2 \cdot 92} + (0 \cdot 14 \text{ to } 0 \cdot 18)$. It is considered that the N^4/A law is only approximate, a more accurate expression being $\tau/\rho = C\lambda^3 N^4/A$, in which C is a constant. The effect of impurities in various absorbing elements has been ascertained. **A. B. W.**

2071. *Critical Potentials and X-Ray Term Values.* **Ann Catherine Davies** and **F. Horton.** (Phil. Mag. 2. pp. 1253–1263, Dec., 1926.)—The critical potentials for the production of soft X-rays from solids have been investigated during the course of the last few years by several investigators [see Abstract 1050 (1926)]. The method employed in such investigations consists essentially in bombarding a solid target of the element under test by electrons from a hot filament, the energy of these electrons being varied by means of the accelerating voltage. The radiation emitted is measured by its photoelectric action on a suitably placed electrode. The voltages at which discontinuities occur in the resulting curves are taken as critical points. The large number of critical points within a certain range has led to disagreement between various observers. The authors now discuss the possible source of disagreement, and propose new or modified methods of examining the problem. **A. B. W.**

2072. *Intensity Distribution in X-Ray Spectra of the Normal Saturated Dicarbocylic Acids, their Diethyl and Mono-Ethyl Esters.* **A. R. Normand, J. D. Ross** and **E. Henderson.** (Roy. Soc. Edinburgh, Proc. 47. 1. pp. 69–80, 1926–1927.)—The above-mentioned series of organic compounds have been investigated by means of X-rays, and from the measurements of the principal spacings a definite chain structure has been assigned to each series. Mathematical formulæ derived by Shearer for similar series of compounds have been applied to these structures and the intensity distribution among the several orders of reflection from the principal planes calculated. These calculated results have been compared with those actually observed from the plates, and the agreement was found to be good in every case, thus confirming the chain structures assigned by the authors to the above series of compounds. **A. B. W.**

2073. *Examination of X-Rays by the Method of Cloud Photography.* **O. Darbyshire.** (Univ. of Durham. Phil. Soc., Proc. 7. 3. pp. 117–124, 1925–1926.)—Measurements are described of the direction of ejection of β-rays produced when X-rays pass through the gas contained in a Wilson expansion apparatus. The right-angle method of photography is employed (two cameras arranged in right-angle position relative to the beam of X-rays), this being considered preferable and more accurate than the ordinary stereoscopic method. Two asymmetrical effects were noticed, one of which is best explained on the classical theory of radiation, whereas the other seems a definite quantum effect. A. B. W.

2074. *Development of X-Ray Spectroscopy during the Period* 1921–1925. **A. E. Lindh.** (Phys. Zeits. 28. pp. 24–62, Jan. 1, and pp. 93–126, Jan. 15, 1927.)—The paper contains a fairly complete summary of the principal developments in X-ray spectroscopy during the years 1921–1925, and is divided into thirteen sections: I. Apparatus—tubes and spectrographs. II. Methods of measurement. III. X-ray spectroscopy of known crystal gratings. IV. Divergences from Bragg's law. Total reflection and refraction of X-rays. V. Emission spectra: K, L, M, and N series. Results of measurements tabulated for all elements. VI. Absorption spectra: K, L, and M series. VII. Experimental investigations on the production of "dark" lines in X-ray spectra. VIII. Intensity measurements on X-ray spectra. IX. ν/R values of the energy levels. X. Dependence of X-ray spectra on the chemical combination (*a*) Absorption spectra, (*b*) Emission spectra. XI. The Compton effect in X-rays. XII. β-ray spectra. XIII. Catalogue of literature, published papers, etc.

The paper contains much tabulated information. A. B. W.

2075. *Measurements and Interpretation of the Intensity of X-Rays Reflected from NaCl and Al.* **J. A. Bearden.** (Phys. Rev. 29. pp. 20–23, Jan., 1927.)—Three methods have been employed: (1) single crystal, (2) reflection from plate of powder, (3) transmission through plate of powder. The results from single and powdered crystal are not in agreement, indicating an uncorrected extinction coefficient in the former. The results from both powder methods are in close agreement. Using the Fourier series formula for electron distribution derived by Compton [see Abstract 308 (1917)], electron distribution curves for Na and Cl have been obtained. The difference in the single and powder crystal curves show that measurements must be accurate to 1 % for reliability. It is shown also that the part of the curves extrapolated to large angles is very important. Similar curves have been obtained for Al, where the distribution curve and the F curve are more satisfactory than with Na and Cl. [See also Abstract 1397 (1925).] J. E.

2076. *The Analytical Interpretation of the X-Ray Spectra of the Fatty Acids and their Mixtures.* **J. J. Trillat.** (Comptes Rendus, 184. pp. 812–814, March 28, 1927.)—Fatty acids have been found to give several distinct crystalline forms according to the mode of preparation and to the purity of the specimen. The author has found that the pure acids always give the same X-Ray spectrum when formed by fusion on a glass plate or by evaporation of an alcoholic solution, and recommends that these methods should be used in identification of specimens. Traces of impurity do not alter the fundamental spectrum, even when they cause small differences in the melting point. With mixtures, the spectral lines lose their sharpness, and their position cannot be predicted from the proportion of the constituents. In some cases lines due to both constituents are observed, while in others this is not so. In adulterated butter, for example, it is possible to trace the addition of margarine by means of its lines. H. N. A.

2077. *X-Ray System.* **V. Dolejšek.** (Comptes Rendus, 184. pp. 964–966, April 20, 1927.)—In considering the validity of the Moseley law throughout the whole periodic system, Bohr and Coster [see Abstract 1398 (1923)] have shown that certain deviations at different levels are predicted according to Bohr's theory of atomic structure. In the present paper the author remarks on the validity of the law in the case of lines and levels close to the nucleus. A. B. W.

2078. *The X-Ray L Spectra of the Lighter Elements.* **J. H. van der Tuuk.** (Zeits. f. Physik, 41. 4–5. pp. 326–331, 1927.)—The author had completed an investigation of the subject before the publication of the recent paper by R. Thoraeus dealing with it. His results in general agree well with those of this investigator, and in the present paper he only deals with certain points of difference, the importance of these anomalies being discussed in terms of the Bohr theory. The L spectrum of gallium, which was not examined by Thoraeus, was photographed, and the wave-lengths of the lines and satellites are given. A remarkable sudden structural alteration of the Lα line was observed in proceeding from the higher elements to Cu (29); in Zn (30) and elements of higher atomic numbers the lines Lα and Lβ_1 are somewhat broadened, but their structures and relative intensity ratios are completely normal. The Cu-Lα line is very much broader, and the other Cu lines are somewhat less sharp; the relative intensity of the Lα has increased as compared with that of the Lβ_1 lines, and the satellites Lα' and Lα'' have suddenly moved much nearer to the main line. The broadening is also found with Ni (28) and Co (27). The lines in question are of great interest, since they correspond to electron springs, in which the 3_3 electron takes part. From Sc (21) to Cu (29) the three quantum electron group is filled up by the addition of the 3_3 electrons; they are here bound quite loosely. The group is closed in the case of copper, but the binding is still loose. This is not the case for zinc. The author agrees with Coster and Druyvesteyn in their explanation of the satellites on the soft side of Lα in Ni, and deals with their theory in detail. H. N. A.

2079. *An Exception to the Intensity Rule in X-Rays.* **A. Jönsson.** (Zeits. f. Physik, 41. 11–12. pp. 801–805, 1927.)—The intensity relation of the characteristic X-ray lines Lβ_3 and Lβ_4, which form a relativity doublet, has been measured with a Geiger counter for the elements Mo, Rh, Pd, Ag and Sn. According to the intensity rules, one should expect the relative intensity of 2 : 1, whereas the experimental value is approximately 3 : 2. For these lines a considerably greater breadth is observed than for other stronger lines in the L spectrum. W. V. M.

2080. *An Investigation of the Action of the Geiger Point Counter with Soft X-Rays.* **K. Molin.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. 4. pp. 1–25, 1927. In German.)—The counter was used at reduced pressure, 500 mm., the Kα_1 and Kα_2 lines of iron being admitted to the chamber. The deflections of a single thread electrometer were registered photographically, and it was found that there were several different classes of amplitude. These were investigated, and it was concluded that four different ionisation processes took place in the counter chamber, the relative frequencies of these being 74·5, 19·7, 5·3, and 0·5 %. The deflections for these processes stood in the ratio 1 : 18 : 2·6 : 3·2; the deflections, however, were not proportional to the quantities of electricity, and it is assumed that these were in the ratio of 1 : 2 : 3 : 4. The author endeavours to explain these results by means of recent observations and measurements of the splitting off of electrons from atoms by X-rays in the Wilson cloud chamber, which show that several electrons may be split off by a single quantum from an atom. The distribution curves of the registered deflections were investigated and compared with the theoretical curves. H. N. A.

RADIOACTIVITY.

2081. *Coloration and Luminescence due to Becquerel Rays. Part II.* **K. Przibram.** (Zeitz. f. Physik, 41. 11–12. pp. 833–847, 1927.)—Continues a previous paper [see Abstract 882 (1924)], and gives a summary of the results obtained at Vienna during the last three years. Much of the work on coloration is dealt with in recently published papers by the author [see Abstracts 958 and 959 (1927)]. The paper also deals with radio-photo-luminescence, kathodo-thermoluminescence and radio-fluorescence and the relation between these and the coloration of salts by means of Becquerel rays. H. N. A.

2082. *Ionising Powers of RaB and RaC.* **H. Jedrzejowski.** (Comptes Rendus, 184. pp. 596–598, March 7, 1927.)—When the γ-radiations of sources consisting of radium-active deposit are compared with those from a bulb of radon, the values depend on the proportions of RaB and RaC and the way in which their respective γ-rays act; these proportions vary with the time. A theory is worked out which, from observations during the disintegration, makes it possible to determine the ionising powers of each of these elements, but it is necessary that the active deposit should be rigorously in equilibrium with radon at time $t = 0$, and should then be instantly separated from it. This is impossible in practice, since emanation is absorbed by the surface of the active deposit. A method is described by means of which a correction can be made for this absorbed radon. The results have been checked by experiments in which the rays from RaB were filtered out by a lead screen and the ionisation due to RaC measured. Thick aluminium screens were also employed for the same purpose. With screens thicker than 60 mm. it was impossible to find any effect from the RaB. H. N. A.

2083. *Relation between Atomic Weights of Isotopic Radio Elements and the Velocity of their α-Particles.* **G. Fournier.** (Comptes Rendus, 184. pp. 878–880, April 4, 1927.)—The author shows that the following expression gives the velocity of α-rays from any radioactive source: $v = v_0 - k\text{A}$, where v_0 is a quantity which varies from one group of isotopes to another, A is the atomic weight of the radio element, and k is a constant. A. B. W.

2084. *Influence of the Nature of the Support on the Emission of Radon.* **G. Vaugeois.** (Comptes Rendus, 183. pp. 1277–1279, Dec. 20, 1926.)—Work of Curie, Rutherford, Soddy and others has shown that the emission of radium emanation takes place with greater difficulty in the solid than in the liquid state of the radium compound. The author has proved successful in using water-glycerine mixture with the radium compound, this

V.3
192

providing the necessary humidity for the free liberation of emanation whilst dissolving only a very small amount. Similarly radium solutions have been prepared using glycerine and inert substances (pure carbon, quartz, silver, etc.) to prevent movement of the solution. The radium compound thus retains its solid state, with the requisite amount of moisture for efficient emission of emanation. The advantages of this method of increasing the emanation evolved whilst retaining the solid condition are pointed out in view of the many therapeutic applications. A. B. W.

2085. *Synthesis and Disintegration of Atoms. Wilson Cloud Method.* **W. D. Harkins** and **H. A. Shadduck.** (Nat. Acad. Sci., Proc. 12. pp. 707–714, Dec., 1926.)—The paper refers to previous work of a similar nature [see Abstract 287 (1924) and Blackett, Abstract 1680 (1925)]. The purpose of the present paper is to give the results obtained from 34,000 photographs of α-ray tracks in nitrogen, containing an average of 12 α-ray tracks per photograph, or in all 270,000 tracks of 8·6 cm. and 145,000 tracks of 4·9 cm. range. In a small percentage of cases close collision with atomic nuclei has been observed and the tracks of the disintegrating particles have been measured. A. B. W.

2086. *Making H-Particles Audible.* **G. Ortner** and **G. Stetter.** (Phys. Zeits. 28. pp. 70–72, Jan. 15, 1927.)—Using a Geiger α- or β-particle counter and a 3-electrode valve, it is possible to obtain sufficient current charge in the plate circuit of the valve, on entry of an α-, β-, or H-particle into the counting chamber, to operate a loud speaker. The author claims to distinguish between the effects of β- and γ-rays and the H-particles. A. B. W.

2087. *Behaviour of Substances of Different Atomic Numbers towards Ultra-γ-Radiation and the Natural Activity of the Elements.* **G. Hoffmann.** (Ann. d. Physik, 82. 3. pp. 413–431, Feb. 8, 1927.)—On the assumption that the "Hess" radiation has the character of ultra-γ-radiation, the author discusses the behaviour of the scattered radiation in the light of the Compton effect. The absorption measurements in lead discriminate clearly between the surrounding radiation and the "Hess" radiation. On various grounds there appears to be a very hard component. Measurements with lead, zinc, copper, iron, aluminium and water absorbers show also for the penetrating radiation a definite scattering effect, such as might be expected from Hess's ultra-γ-radiation. The equality of the rest-currents—*i.e.*, for very great thicknesses of absorber—for the different metal screens indicates that the radium content of the different metals used is less than 10^{-14} gm. Ra/1 gm. substance; this is considered a conclusive support to earlier work on the natural activity of the elements. A. B. W.

2088. *Capture of Electrons by Swiftly-Moving Electrified Particles.* **L. H. Thomas.** (Roy. Soc., Proc. 114. pp. 561–576, April 1, 1927.)—A mathematical paper. The chance that a fast α-particle will capture an electron is calculated in two cases: for particles with velocity greater than 8×10^8 cm./sec. moving through hydrogen or helium, and for particles with velocity between 4×10^8 and 2×10^9 cm./sec. moving through heavy matter. The method is to split up the process into a close collision of the particle with an electron and a close collision of this electron with an atomic nucleus. The results obtained are compared with the available experimental results, and the agreement is satisfactory. A. B. W.

2089. *Relative Intensities of Groups in the Magnetic β-Ray Spectra of RaB and RaC.* **C. D. Ellis** and **W. A. Wooster.** (Roy. Soc., Proc. 114. pp. 276–288, March 1, 1927.)—The relative intensities of the β-ray groups in the RaB and RaC magnetic spectrum have been measured for equal numbers of disintegrating atoms. The ratio of the intensities of the groups arising by internal absorption of a γ-ray in the L and K levels is independent of the frequency of the γ-ray, and approximately equal to that applying in the case of external absorption of X-rays. A. B. W.

2090. *The Straggling of α-Particles from Radium C.* **G. H. Briggs.** (Roy. Soc., Proc. 114. pp. 313–340, March 1, 1927.)—Radium active deposit was collected on a short, thin platinum wire, in front of which was a sheet of mica; 10·5 cm. from this was a copper plate with four slits parallel to the wire, and a photographic plate was placed 10·5 cm. beyond this. The whole was contained in a brass box, the pressure in which was reduced to less than 10^{-4} mm. of mercury, and which was placed between the pole pieces of an electromagnet, the field being a very uniform one. The undeflected and the deflected lines were photographed and also the deflected lines due to α-rays which did not pass through the mica, and the distribution of density in these bands were measured with a microphotometer. Details are given of the method employed in calculating the distribution of velocities from the observed broadening of the deflected bands by different thicknesses of mica, results being given for emergent velocities from $0·98\ V_0$ to $0·22\ V_0$. The distribution of energies was nearly Gaussian in form, as Bohr's theory indicates. The straggling of the ranges takes place most rapidly near the beginning of the range; it was everywhere found to be about 1·4 times that predicted by Bohr's theory. This indicates that for a small element of path ΣQ^2 is approximately twice as great as in Bohr's theory, where Q is the energy transferred to an electron. The results are compared with those obtained by I. Curie, by I. Curie and Mercier, and by Meitner and Freitag. The Henderson-Fowler theory is also considered. H. N. A.

2091. *The Decrease in Velocity of α-Particles from Radium C.* **G. H. Briggs.** (Roy. Soc., Proc. 114. pp. 341–354, March 1, 1927.)—The apparatus used was the same as that employed in the author's investigation of the straggling of α-rays in mica [see preceding Abstract]. For this purpose the mica was placed so as not to cover the source completely, and for each slit an additional line was produced corresponding to V_0; a correction was made for the fact that the deflection is not exactly proportional to $1/r$, where r is the radius of curvature of the path. For velocities less than $0·55\ V_0$ the decrease in velocity was much more rapid than that found by Marsden and Taylor, but near the end of the range agreed with the results of Kapitza and of I. Curie. The ratio of the number of singly to doubly charged α-particles at different velocities appears to vary as $V^{-4·3}$. The variations of the initial velocities were investigated; there was no evidence of velocities greater than the average by more than 1 in 3000. Velocities observed less than the maximum were probably due to absorption in the source. H. N. A.

HEAT.

2092. *The Wiedemann-Franz Law. Part II.* **A. Eucken** and **K. Dittrich.** (Zeits. phys. Chem. 125. pp. 211–228, Feb., 1927.)—In continuation of earlier work [see Abstract 2991 (1924)] an investigation is made of the extent to which the thermal conductivity of metals can be separated into a specific metallic component λ_m which predominates in good conducting metals and large crystals and a non-metallic or crystal component λ_k which predominates in non-metals and mixed crystals. Measurements are made of the thermal conductivities of the pure metals, iron, nickel, thallium, and the alloys Cu, Mn; Pb, Tl; and Cu, Mi at temperatures of 80° and 273° C. abs. The effect is determined of varying the crystal grain size of the alloy by recrystallisation and heat treatment. A formula is derived to express the relation between the value of λ_k, and crystal size with metals. With pure substances which have a relatively small crystal lattice λ_k changes inversely proportionally to the absolute temperature, while λ_m remains constant. Use is made of data obtained by Bridgman on the influence of pressure on the term λ/χ, where χ is the electrical conductivity ,whereby the component $\lambda m/\chi$ is independent of pressure. It is concluded that the quotient $\lambda_m/\chi T$ approaches at high temperatures to a universal constant. J. N. P.

2093. *Some Problems in the Conduction of Heat.* **G. Green.** (Phil. Mag. 3. pp. 784–800, April, 1927. Supplement.)—Many problems in heat conduction involve the transference of heat from one medium to another. A method is worked out where all heat conduction problems are treated as problems in wave motion. Instead of building up solutions from point sources or doublet sources, they are built up from wave trains. In this way the methods and principles employed in wave-motion problems become available for heat conduction. Cases are considered where a wave train arrives at a boundary at which radiation takes place, or where there is a change in the medium, and the temperature at any point is determined. Fundamental solutions are given for plane and for spherical waves. Discussion of solutions in terms of cylindrical waves is to be given in a later paper. T. B.

2094. *Emissivity Methods of Investigating Thermal Conduction in Metals.* **H. Gregory** and **C. T. Archer.** (Phil. Mag. 3. pp. 931–944, April, 1927.)—The basis of emissivity methods is to connect the emission of heat from an electrically heated wire with the thermal conduction of its material. Reference is made to Jaeger and Diesselhorst's experiments and to a method proposed by Callendar. The present authors have employed controlled conditions of pressure, and of the nature and extent of the medium surrounding the wire, under which Newton's law [$H_e = \lambda . \theta$, where λ is a constant] is applicable. In such a case, when the electrically heated wire is placed in a gaseous atmosphere bounded by a surface symmetrical with the wire, we have $H_e = (2\pi K_g\theta)/\log r_2/r_1 +$ convective loss + radiation, the first term representing loss of heat by conduction through the gas. In certain dispositions of apparatus the convection and radiation become negligible, and $H_e = \lambda\theta$. A determination of the thermal conductivity of platinum has thus been made by the authors, due attention being paid to a choice of the dimensions of the wire and the surrounding tube. A suggested method of determining the thermal conductivity of metals at high temperatures is discussed. T. B.

2095. *Tungsten-Wound Furnaces for High Temperatures.* **W. Fehse.** (Zeits. techn. Physik, 8. 3. pp. 119–122, 1927.)—Describes a number of different forms of furnaces designed for high-temperature operation, one being for service up to 2200° C. Details of design and constructional diagrams are given. The particular feature of these furnaces is that they can be readily taken down for renewal of the heating element. J. W. T. W.

2096. *Surface Energy and Heat of Solution of Solid Sodium Chloride. Part I.* **S. G. Lipsett, F. M. G. Johnson** and **O. Maass.** (Am. Chem. Soc., J. 49. pp. 925–943, April, 1927.)—The heat of solution of pure solid sodium chloride, in the coarsely crystalline form and also in a finely divided state obtained by sublimation, is determined in a new type of adiabatic calorimeter, which enables small quantities of material to be used and gives highly accurate results over a wide range of concentrations. The heat of solution of the coarse salt is 895·8 cal. per mol.; of the fine salt, 883·5 cal., after allowing for the effect of water vapour on the fine salt as determined in a separate series of experiments. From this the surface energy of solid sodium chloride at 25° C. is approximately 400 ergs per sq. cm. B. W. C.

2097. *Mechanical Equivalent of Heat.* **J. M. Cork.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 99–102, Jan., 1927.)—Gives a description of an apparatus for determining the mechanical equivalent of heat by measuring the heat developed within a stationary copper cylinder as well as the torque developed by it when placed in a rotating magnetic field. The field strength is made unvarying with angular position by the actual rotation of an electromagnet with slip-rings. Radiation loss is reduced to a minimum by immersing the copper cylinder in water contained within a thermos bottle. In addition to the mechanical and heat energy measurements, the equivalent electrical energy is measured at the same time. C. O. B.

2098. *Vapour Pressure and Heat of Dilution of Aqueous Solutions. Part IV. Improved Method of Measuring Vapour Pressure by Air Bubbling.* **H. I. Downes** and **E. P. Perman.** (Faraday Soc., Trans. 23. pp. 95–106, March, 1927.)—The method now described for measuring vapour pressure is essentially that of Perman [see Abstract **1262** (1904)], with a number of improvements and safeguards. Values are given for the vapour pressures of aqueous sucrose solutions over a wide range of concentrations at 40°, 50°, 60°, 65°, 70°, 75° and 80° C., together with the corresponding densities of the solutions. Worthy of note are the small effect of change of temperature on the vapour pressure and the close agreement of the numbers with those calculated from the ideal equation, even with solutions as strong as 25 %. T. H. P.

2099. *The Thermodynamic Equilibrium Concentration of Cosmic Matter.* **P. Jordan.** (Zeits. f. Physik, 41. 10. pp. 711–717, 1927.)—O. Stern has recently [see Abstracts **2724** (1925) and **1940** (1926)] obtained an expression for the thermic equilibrium concentration of matter, under the assumption that, according to an idea investigated by Eddington, positive and negative electrons are annihilated by opposite sides neutral-ising and are transported in radiation energy, or, conversely, can be formed by radiation from thermodynamic considerations. In the present paper the considerations of Stern and Lenz are investigated from the standpoint of the Einstein and Fermi gas theory. The probability laws for the elementary processes in the transformation of matter in radiation is also dealt with. A. E. G.

2100. *The Principle of the Unattainability of Absolute Zero.* **F. Simon.** (Zeits. f. Physik, 14. 11–12. pp. 806–809, 1927.)—It is postulated that an arrested system, such as a supercooled liquid, solution, or metastable crystal condition, for which there is still an entropy change at absolute zero, cannot be employed for the attainment of absolute zero. This is illustrated by data for helium, which indicates that the temperature coefficient of the melting pressure disappears at absolute zero. Similar relations apply to the entropies of amorphous glass and supercooled glycerine previously considered. [See Abstract 2911 (1926).] According to the theorem of the unattainability of absolute zero, the entropy differences of all the states of a system between which a reversible transition can occur disappears at the lowest temperatures. J. N. P.

2101. *Absolute Zero of the Externally Controllable Entropy and Internal Energy of a Substance and a Mixture.* **R. D. Kleeman.** (Phil. Mag. 3. pp. 883–895, April, 1927.)—Attention has recently been given to the properties of the internal energy and entropy of a substance at the absolute zero of temperature and the connection of these properties with those at higher temperatures. Relating to this subject, Nernst enunciated his well-known heat theorem, and further developments resulted in a theorem often called the Third Law of Thermodynamics. The object of this mathematical paper is to show that these results are only cases of a much more general result, which can be deduced directly from results of an axiomatic character. J. J. S.

2102. *Quantum Problems of Heat.* **A. Smekal.** (Zeits. techn. Physik, 8. 2. pp. 68–71, 1927.)—It is shown that the usual method of estimation of quantum mass on the basis of thermo-microscopic measurement is defective and is only useful as a makeshift. By proper treatment it is, however, possible to utilise this kind of measurement, as a basis of the quantum equations, to establish the molecular weights and energy without further reference to the quantum theory expressions. The fundamentals derived from modern statistics are totally independent and different from the results obtained from the old classical statistical mechanics to a far-reaching degree. The paper is theoretical. S. G. B.

2103. *Solution of van der Waals' Equation at the Critical Point.* **V. Kirejew.** (Zeits. Elektrochem. 33. pp. 91–94, March, 1927.)—The usual method of solution of van der Waals' equation at the critical point allows of three solutions. The values of the constants *a* and *b* can only be determined by means of critical pressure and temperature, and calculating from experimental data the fundamental equation is not exactly satisfied. The analysis of the solution lends to an approximate formula for the cohesion function at the critical point. The equality of the sum of the cohesion energy and the energy of external pressure is established with the quantity $\frac{3}{2}RT_K$ at the critical point. The paper is theoretical throughout. S. G. B.

SOUND.

2104. *Acoustic Constants of Cloth.* **K. Kurokawa.** (Inst. El. Eng. of Japan, J. Selected Papers, No. 12. [32 pp.], Dec., 1926.)—Expressing pressure and velocity as plane vectors, the complex ratio of the two is called, on the electric analogy, the acoustic surge impedance density. If a wave W, after travelling a distance x, is expressible as $We^{-\alpha x}$, α, which in general is complex, is called the attenuation constant. Measurements are made of the motional impedance of a telephone receiver coupled with an acoustic tube containing the cloth under test as a sound screen. For a given frequency three measurements under different conditions suffice to determine the surge impedance density and the attenuation constant. From these are calculated reflection and transmission coefficients, etc. G. A. S.

2105. *Speed of Explosion Waves.* **T. Vautier.** (Comptes Rendus, 184. p. 76, Jan. 10, 1927.)—The employment and interpretation of the graphical method for the representation of the development of explosion wave-forms as previously described [see Abstracts 1252 and 1253 (1927)] are discussed and the possible extent of the differences between the respective velocities of the wave-front and of the summit is indicated. A. B. C. L.

2106. *Tuning-Fork Calibration.* **E. Klein** and **G. F. Rouse.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 263–286, March, 1927.)—A useful critical survey of methods used for exciting and calibrating tuning forks. The paper, which is accompanied by a bibliography of forty-two references, is one of the series of reports on research methods and technique prepared for the National Research Council of America. W. H. Ge.

2107. *Measurement of Small Time Intervals.* **P. P. Quayle.** (Frank. Inst., J. 203. pp. 407–412, March, 1927.)—Deals with the measurement of such small intervals of time as are involved in the study of temperature and amplitude effects on the frequency of tuning forks. The standard is a free pendulum swinging *in vacuo*, and a beam of light passing through the pendulum case falls on a potassium hydride photoelectric cell suitably connected to a three-stage resistance-coupled amplifier and through a transformer to a standard General Electric oscillograph. The light from this is received on a special high-speed camera. Diagrams and full details are given. W. H. Ge.

2108. *Pinhole Probe Experiments with Massive Air Columns.* **C. Barus.** (Nat. Acad. Sci., Proc. 13. pp. 87–91, March, 1927.)—Extends the work of previous papers on the acoustic pressure indicated by the pinhole probe to broad and long pipes. The results are set out in six sets of graphs. W. H. Ge.

2109. *Echoes.* **E. Meyer.** (Elek. Nachrichten. 4. pp. 135–139, March, 1927.)—A qualitative study undertaken with the Reiss microphone amplifier and oscillograph of reflection and absorption of pure tones and noises. Many of the actual records are reproduced. W. H. Ge.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2110. *Analysis of the Electromagnetic Field into Moving Elements.* **S. R. Milner.** (Roy. Soc., Proc. 114. pp. 23–46, Feb. 1, 1927.)—By means of transformation, certain of Maxwell's equations of the electromagnetic field are expressed in terms of two vectors, R and *u*, at right angles to each other and of a scalar function of position a. The equations obtained reveal that the most general electromagnetic field in regions not containing charges can be represented by a vector R of invariant magnitude the lines of which at each point are in motion at right angles to themselves with a definite velocity *u* relatively to the observer; and further, that small moving elements of the field can be constructed which can be regarded as keeping their identities permanently as they move. The movement takes place under stress in accordance with the fundamental laws of dynamics, and, besides, independently the elements exhibit in the general case coordinated rotational movements. Every property of the field can be specified directly in terms of these moving and rotating elements. A field element considered in space-time as a four-dimensional element appears as an element of *action*, and the analysis shows that the general electromagnetic field can always be divided in a natural way into such elementary units of action, and it is possible that both field elements and the corresponding elements of action may have a finite magnitude in the field. These results are developed directly from the fundamental equations without referring to four-dimensional theory except occasionally.
J. J. S.

2111. *Planck's Oscillator.* **R. Ferrier.** (Comptes Rendus, 184. pp. 585–587, March 7, 1927.)—It was shown in a previous paper [see Abstract 2152 (1926)] that Planck's oscillator may be conceived as a simple perturbation of the ether, susceptible of oscillating on itself instead of dispersing into space like the special perturbations known as electric waves. The laws underlying such an oscillation differ from those of ordinary waves in that the electric field has no eddy and that its evolution, previous to the formation of a singular point, is indicated by prequantic equations. The general equations established by the author to complete those of Maxwell (*The New Electronic Axioms*, Blanchard, 1925, p. 49) solve the problem of Planck's oscillator when the electric field has a singularity. They give an integral of energy applicable only to the case in which the fields are regular and zero at infinity. In every other case, and notably when there are critical points, this equation of energy becomes distinct. The author proceeds to give for the field of the oscillator an expression which shall satisfy the various conditions. The slight damping observed in luminiferous oscillations indicates a discontinuous structure of the ether. The equations hold good, strictly speaking, only at a distance from the critical point greater than 10^{-13} cm. (in order of magnitude). This limitation probably accounts for the fact that no elliptic emission of light is observed; the field lines and the current lines form an unvarying figure only when the vibration is rectilinear or circular. This theory will be developed in a future paper.
E. F.

2112. *Theory of the Linear Electric Oscillator and its Bearing on the Electron Theory.* **G. A. Schott.** (Phil. Mag. 3. pp. 739–752, April, 1927. Supplement.)—It has been the custom, after the manner of Helmholtz and Kelvin, to describe the oscillatory discharge of an electrically-charged condenser through a resistance and self-induction by means of the equations of energy and motion of the ordinary mechanical oscillator with one degree of freedom, *viz.*: $\frac{d}{dt}(\frac{1}{2}\dot{x}^2 + \frac{1}{2}\mu x^2) + \chi\dot{x}^2 = X\dot{x}$, and $\ddot{x} + \chi\dot{x} + \mu x = X$. It was soon recognised that the electric oscillator differs from the ordinary mechanical oscillator in so far as it radiates electromagnetic energy and that a rigorous theoretical treatment should take account of this fact. This paper deals with that question, and the following points are also specially considered: Rigorous expression for the internal mechanical force, the uniform spherical surface electron, the convergence of the series, the corrected equation of motion of the linear electric oscillator, the classical electron theory, the hypothesis of Nordström and Leigh Page. A. E. G.

2113. *Electrostatic Problems Concerning Certain Inverted Spheroids.* **D. M. Wrinch.** (Phil. Mag. 3. pp. 865–883, April, 1927.)—A mathematical discussion of various problems of electrostatics associated with the surfaces obtained by inverting an oblate spheroid with respect to a point on the axis of symmetry. J. J. S.

2114. *Surface Tension and Electric Charge.* **O. Ruff, G. Niese** and **F. Thomas.** (Ann. d. Physik, 82. 5. pp. 618–626, March 22, 1927.)—A relation is developed for the dependence of the surface tension on the surface of a spherical conducting drop on the density of the electric charge. This relation is experimentally confirmed for mercury. J. J. S.

2115. *Electrometer Capacities.* **O. Ruff, G. Niese** and **F. Thomas.** (Ann. d. Physik, 82. 5. pp. 627–630, March 22, 1927.)—Details are given of an extension of Harms' drop method of determining capacities. Harms worked with a maximum tension of the drop electrodes of 220 volts. The authors have used high tensions up to 22,600 volts. J. J. S.

2116. *Behaviour of Drops in Electric Fields.* **O. Ruff, G. Niese** and **F. Thomas.** (Ann. d. Physik, 82. 5. pp. 631–638, March 22, 1927.)—The behaviour of drops of various organic and inorganic liquids in electric fields of high tension was investigated, especially as to the extent of the possibility of their electrostatic charge and as to illumination phenomena in their charged condition. Liquids were allowed to flow from a positively charged electrode at tensions up to 40,000 volts, and it was determined approximately up to what potential liquid drops, jets, or only mist were to be obtained, whether from them whilst still in contact with the electrode brush discharges took place, and whether after their separation from the electrode illumination was shown on their falling through the atmosphere or falling into liquid air. The results obtained with thirty-seven different substances are given in a table. J. J. S.

2117. *Preliminary Note on the Effect of Dust, Smoke and Relative Humidity upon the Potential Gradient and the Positive and Negative Con-*

ductivities of the Atmosphere. **G. R. Wait.** (Terrest. Magn. 32. pp. 31–35, March, 1927. Paper read before the Am. Phys. Soc. Philadelphia, Dec., 1926.)—Results have been obtained from simultaneous observations on the positive and negative conductivities and on the potential gradient of the atmosphere. From these have been computed the ratio of positive to negative conductivity and the air-earth current for various values of relative humidity, visibility, and the numbers of the nuclei of condensation as obtained by an Aitken counter at Watheroo, W. Australia. The measurements were mainly confined to the summer months, when bush-fires abounded. The results are shown in a series of graphs. Generally the potential-gradient curve is a reciprocal of that for the conductivities, while the number of dust particles decreased with increased humidity. The potential gradient and the ratio of positive to negative conductivity decrease with increase in visibility. The potential gradient is abnormally large, and both conductivities are very small during fog. Finally, the atmospheric-electric elements are not affected to the same extent by a change of humidity as by a change in the number of nuclei, possibly because humidity affects the conductivities independently of dust-content.
R. S. R.

2118. *Radioactive Collector for Potential-Gradient Measurements.* **M. A. Tuve** and **C. Huff.** (Terrest. Magn. 32. pp. 17–25, March, 1927.)—A large parallel plate system was used for the production of known potential gradients and the action of a radioactive collector studied under various conditions. It was found that a collector coated on one side only with radioactive material gave a systematic error of 4% in the potential gradient, but its time-average of a variable potential gradient was correct. The effects of leakage, distortion of equipotential surfaces, wind, smoke and other disturbances were examined. Inductive compensation of the apparatus permitted an accurate recording of variations in atmospheric potential gradient rather than a time-average of it. A physical explanation of the action of the collector is given in terms of the diffusion of the ions produced in its vicinity. R. S. R.

2119. *The Electric Fields of South African Thunderstorms.* **B. F. J. Schonland** and **J. Craib.** (Roy. Soc., Proc. 114. pp. 229–243, March 1, 1927.)—The method described by C. T. R. Wilson [see Abstract 122 (1921)] was used in the study of eighteen thunderstorms. The working hypothesis was adopted that a thundercloud is essentially bipolar, with electric charges of different signs at different heights; the relation between the sign of the vertical electric field at the observing station for different distances of the cloud, in terms of the signs of these charges, is worked out, also the effects of lightning discharges within the cloud, or to the ground, in producing sudden field changes when the storm is distant and when it is near. The observations make it probable that nearly all, or possibly all, the eighteen storms were of positive polarity, which suggests that Simpson's theory of the production of the charge by the breaking up of large water drops in an ascending air current must be rejected or radically altered. Positive polarity means that the positive charge is at the top of the cloud, and a preponderance of such clouds is necessary, on Wilson's theory, to maintain the negative charge of the earth's surface. The electric moments of the charges removed by 82 lightning discharges were measured; the mean value is 94 coulomb-kilometres. H. N. A.

DISCHARGE AND OSCILLATIONS.

2120. *" Reflection " of Electrons from Surfaces in Vacuo.* **D. Brown** and **R. Whiddington.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 162–164, March, 1927.)—It has been shown that when a stream of electrons is incident on a solid surface, the surface becomes a source of secondary electrons which come out in all directions, and may have energies from zero up to the full energy of the incident stream. In all cases it appears the majority of the secondary electrons are of very small energy. The present investigation employs a somewhat different experimental method from that usually used. The apparatus is of copper. The source of electrons is a hot tungsten filament from which electrons are accelerated under potentials varying from 50 to a few hundred volts towards a target placed so as to be in a space free of any electric field and yet shielded from any possible sputtering from the kathode. Electrons " reflected " from the target are passed through a fine slit, and so deflected in a uniform magnetic field as to form a velocity spectrum on a suitably placed photographic film. The main fact which emerges from the curve obtained by plotting numbers of electrons as ordinates and energy as abscissæ is that if the incident electrons correspond to an accelerating potential V there is quite considerable " reflection " of electrons of this full energy V, then a gap from V to (V — 12), within which energy range very few electrons are reflected, and then a more or less impartial distribution from (V — 12) towards zero. The general character of the curve appears to be independent of the material of the reflector, the energy of the electrons, and their numbers. The gap of about 12 volts always appears. The explanation of this result is obscure. A. E. G.

2121. *Dispersion of an Electron Beam.* **E. E. Watson.** (Phil. Mag. 3. pp. 849–857, April, 1927. Supplement.)—An electron beam used as an indicating device must have the recording end as small as possible. For instance, in the kathode-ray oscillograph the lines traced on the photographic plate by the beam of kathode rays must be narrow and sharp, while the electrons must have sufficient energy to produce a developable image. The author now submits analysis to show how the beam may be adjusted to work at maximum efficiency. H. H. Ho.

2122. *Direction Distribution of Photoelectrons.* **G. Wentzel.** (Zeits. f. Physik, 41. 11–12. pp. 828–832, 1927.)—The impressed oscillation which is generated in a wave-mechanics atom by a light-wave has been investigated by Schrödinger and by the present author [see Abstract 1500 (1927)]. In both works only the electric action of the primary light-wave was calculated, while its magnetic part, and with it the radiation pressure, was omitted. In the present paper the electromagnetic vector-potential of the light-wave is introduced into the Schrödinger wave equation. The result obtained deviates only in one essential point from those obtained previously; the photoelectrons receive an additive velocity component in the direction of the rays of the amount $h\nu/mc$. The maximum of the photoelectric current, which according to earlier calculations fell in the direction of the electric light vectors, now bends towards the direction of the rays, quite in agreement with experiment. A. E. G.

2123. *Photoelectric Emission, Thermionic Emission and Peltier Effect.* **E. H. Hall.** (Nat. Acad. Sci., Proc. 13. pp. 43–46, Feb., 1927.)—A discussion of the consequences which follow from the assumption that the major part of the current within a metal is carried by means of electrons which go from atomic union to atomic union along the metal without sharing the heat energy, while a much smaller part is carried by means of "free" electrons—*i.e.*, electrons free enough to have the heat energy of monotomic molecules. The author observes that the dual theory of conduction enables a very definite picture to be formed, whether right or wrong, of the operations considered. J. J. S.

2124. *Photoelectric Properties of Outgassed Platinum.* **L. A. DuBridge.** (Phys. Rev. 29. pp. 451–465, March, 1927.)—The total photoelectric emission from a strip of Pt foil excited by the full radiation from a quartz mercury arc was studied while the strip was put through an extended heat treatment in pressures as low as 10^{-8} mm. Hg. Prolonged heating at 1200°–1400° C. caused the photo-current to decrease to a final value, which was not reduced by heating for 300 hours at temperatures up to the melting point. The long wave-length limit was determined. The threshold was found to shift during outgassing from above 2500 Å. to a final steady value of 1958 ± 15 Å. Pressure readings confirmed the conclusions (*a*) that decreasing photo-currents are caused by the evolution of absorbed gases, (*b*) that increasing photo-currents (recovery effect) on cooling are due to the adsorption of gas by the cool Pt surface, and (*c*) that the final low values of the photo-emission are characteristic of the gas-free Pt. The photoelectric effect of Pt was found to be independent of the temperature only in the region below 500° C. At higher temperatures up to 1200° C. the photo-currents increase considerably with temperature and the threshold shifts slightly to the red. This appears to be a genuine temperature effect characteristic of the metal itself, and may be due to the increase in the thermal energies of the "free" electrons becoming appreciable at the higher temperatures. J. J. S.

2125. *Grouping of Gaseous Ions.* **W. Busse.** (Ann. d. Physik, 82. 5. pp. 697–712, March 22, 1927.)—Further experimental work is described, which confirms in every way the author's previous results [see Abstract 406 (1927)]. In experiments on ionisation, produced by spraying water and also by oxidation of phosphorus, the distribution of the dimensions of ionic groups was found to be quite continuous. With radioactive ionisation also no preponderating size of ionic groups was in any case observed. A. W.

2126. *Influence of Gas Content on the Velocity Distribution of Photoelectric Electrons from Platinum, Aluminium and Palladium.* **J. Kluge.** (Ann. d. Physik, 82. 3. pp. 432–448, Feb. 8, 1927.)—It is shown that for platinum and aluminium the relation between velocity of emission and limiting wave-length, as expressed by the Einstein law, is verified and is independent of the amount of gas contained in the metal. The velocity distribution, however, varies with the amount of gas present in the metal, the mean velocity V varying in the same sense as maximum velocity V_m. A. B. W.

2127. *Mobility of Ions in Ion Rays.* **F. Köther.** (Ann. d. Physik, 82. 5. pp. 639–663, March 22, 1927.)—G. C. Schmidt (see Abstract 98 (1925)] has shown that a large number of salts send out positive ions at proportionately low temperatures. These consist, as is shown by measurements of e/m, of metal ions of the salts. It is shown in the experiments here described that a temporary constancy of positive-ion emission from heated salts is reached by using a large surface and higher temperatures. The mobility of the emitted positive ions, measured by the Rutherford alternating-current method, is found in the case of the halogens of silver and cadmium at temperatures 325° to 425° C. to be some centimetres per second. The mobility of the ions increases with the temperature. Raising the number of alternations causes an increase in the mobility. The differences of the mobility of the thermions in the ion rays, as found in the present experiments for all temperatures, paths and time, are more easily explained by a cluster theory than by a theory of simple molecular ions. A. E. G.

2128. *Ion Rays.* **G. C. Schmidt.** (Ann. d. Physik, 82. 5. pp. 664–682, March 22, 1927.)—This paper is a continuation of work the results of which were recently published [see Abstract 2938 (1926)]. The emission of ions from the following pure salts is investigated: AgCl, AgI, $PbCl_2$, CdI_2. It is found that at the lower temperatures used $PbCl_2$ sends out only — ions, the remaining salts + ions. The emission, in general, diminishes with the time, at many temperatures extremely quickly, *e.g.*, with AgCl at 330° C., from 1240 to 2 in 8 minutes. At higher temperatures a rising or quite irregular curve is obtained with AgCl, but at still higher temperatures there is again a change to a falling curve. In the neighbourhood of the melting point the emission is temporarily constant. Falling curves are normal for pure salts at the lower temperatures; these falling curves can be changed into rising curves by chemical reactions brought about by the presence of impurities. It also appears as if many pure salts at certain temperatures are able to give rising curves. It would appear that the alteration of the emission with the time depends upon alterations in the surface of the salt. A. E. G.

2129. *Conductivity of Clouds dispersed from an Arc. Part II.* **H. P. Walmsley.** (Phil. Mag. 3. pp. 587–600, March, 1927.) In a previous paper [see Abstract 2161 (1926)] it has been shown that the type of ionisation currents obtained from the cloud of particles produced from an arc between cadmium electrodes depends upon the mass of material dispersed. For sparse clouds a curve is obtained which approximates to that which is given by ions disappearing according to the ordinary law of recombination, but as the concentration of the cloud increases, a rise appears in the ionisation curve, usually within the first half-hour, and produces a marked minimum. With increasing concentration, the minimum approaches the origin of time and becomes less marked. The initial fall in current strength has already been attributed mainly to recombination. In the present paper it is shown that the subsequent rise is due either to the production of new charges within the cloud as it ages, or to an increase in the mobility of existing ions. In either case it follows that during the process of coalescence the cloud particles form unstable aggregates which subsequently disrupt and give rise to the observed effect. As a result of the disruptive process, the particulate number curve does not decrease indefinitely as the cloud ages, but flattens and tends to approach an equilibrium value. The following points are dealt with: The distribution of the initial charges on the particles; mobility changes due to coalescence and disruption; origin of the ions produced after dispersal; effects due to the instability of certain complex particles. A. E. G.

2130. *Positive Rays and Application to the Separation of Isotopes.* **M. Morand.** (Ann. de Physique, 7. pp. 103–183, March–April, 1927).—The emission of positive rays appears to be determined by the existence of powerful electric fields at the surface of salts heated or suitably bombarded. Calculation of the order of magnitude of these electric fields gives results between 10^7 and 10^8 volts per cm. Such fields appear to be experimentally possible. It is shown that the elementary phenomena of the emission of positive rays should be necessarily accompanied by secondary effects, and the form these effects should take is discussed. Experiments on the emission of positive rays by points covered with metallic salts have verified these theoretical conclusions, which also explain results obtained by previous experimenters. The results have led to an improved technique for obtaining intense emissions, homogeneous and suitably controlled. An attempt has been made to utilise these emissions to obtain the separation of the isotopes of lithium in quantities appreciably greater than have hitherto been possible. It appears possible to obtain with ease quantities of 0·01 milligramme. Further improvements in the methods employed should increase this quantity considerably. The light emitted under certain conditions under the action of the bombardment of the kathode by the positive rays of lithium contains some new lines of this element. These belong to the spark spectrum, and allow the calculation of a double ionisation potential in the neighbourhood of 65 volts. A. W.

2131. *Intermittent Valve Oscillator.* **L. S. Taylor.** (Frank. Inst., J. 203. pp. 351–374, March, 1927.)—By an intermittent valve oscillator is here meant an oscillating circuit maintained by a thermionic valve which oscillates only during certain definite intervals of time. The periods of normal oscillation, when interspersed by intervals of silence, are termed "zules"; the term "beat" was previously applied to the same effect [see Abstract 1452 (1926)]. The effect may be procured by the insertion of proper high resistance and capacity into the grid circuit of an oscillator. The circuit used here, a diagram of which is given, is of a modified Hartley type. Ordinarily such a circuit requires no blocking condenser before the grid in order to maintain the mean grid potential at a value sufficiently negative to give strong oscillations. However, such a condenser properly shunted by a moderately high resistance may be inserted between the grid and filament in several ways without seriously modifying the oscillation characteristics of the circuit, provided that the resistance does not exceed some definite maximum value. When the resistance exceeds this value, the oscillations are interrupted by periods of silence. In the present experiments a high resistance of very constant value and a variable mica condenser in parallel are placed in the circuit. A. E. G.

2132. *Oscillatory Circuits with Iron-Cored Coils.* **H. Winter-Günther.** (Zeits. f. Hochfrequenztechn. 29. pp. 81–82, March, 1927.)—If it is required that the results obtained with one oscillatory circuit with an iron-cored coil shall be also obtained with another similar circuit, it is here shown that a certain equation must be satisfied in both cases. From this it follows that the natural frequency and damping must be the same in both cases, and also that the ratio of the coil inductance to that given by a core of unit permeability must be the same in both cases. In the case of two circuits coupled either (*a*) conductively or (*b*) inductively by means of (*a*) a single coil or (*b*) two separate coils wound on an iron core, similar relations are found to hold. A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2133. *Unipolar Conductivity of Lead Sulphide.* **H. Lüke.** (Phys. Zeits. 28. pp. 213–221, March 15, 1927.)—A continuation of the work of F. Trey [*ibid.*, 26. p. 849, 1925] on the action of natural and artificial crystal detectors. Pure metals or alloys cannot act as rectifiers. The rectifying power of galena (plates) is not increased by roughening the surface (against Thieme). All crystals lose the power on being powdered, but regain it partly when the powder is compressed. Heating to 200° C. hardly affects the unipolar conductivity of large crystals, but compressed crystals heated to 150° C. are better rectifiers after cooling in the sense of the whole crystals. Chemically precipitated and dried PbS conducts the current equally well in both directions; when heated in a vacuum to 150° C. it does rectify; mere compression in a vacuum (not in air) confers some unipolarity upon the mass. That powders are poorer rectifiers than the larger crystals is due to adsorbed gas and moisture and can be cured by heat and evacuation. When a crystal plate is heated to 600° C. the sense of the rectification is reversed, because the plate becomes covered with sharp, sublimed needles, which act as the point electrode opposite the plate had done before. H. B.

2134. *Transverse Magneto-Resistance Effect in Single Crystals of Iron.* **W. L. Webster.** (Roy. Soc., Proc. 114. pp. 611–619, April 1, 1927.)—The resistance of single crystals of iron was measured in a magnetic field perpendicular to the current. Rods were cut with their axes parallel to a crystal axis, and a current of 1·5 amps./mm.^{2} was sent through them. Graphs show the change of dR/R with the field in a series of positions in planes normal to the crystal axes. Below 5000 gauss and above 12,000 gauss there is a gradual decrease in resistance which is approximately proportional to the field. In the region between, the change of resistance is rapid, and is positive when the current is along a cubic axis and negative in the other two directions. The effect vanishes when the field is along a cubic axis. It is suggested that the effect is twofold, and consists of a gradual change of resistance due to some direct action of the field of the conducting electrons and a rapid change due to the change of orientation of the atoms which accompanies magnetisation. [See also Abstracts 861 (1926) and 1132 (1927).] G. E. A.

2135. *Transverse Thermoelectric Effect in Metal Crystals.* **P. W. Bridgman.** (Nat. Acad. Sci., Proc. 13. pp. 46–50, Feb., 1927.)—Kelvin predicted that if a bar of crystalline substance possessing an axis of thermoelectric symmetry has its length oblique to this axis, a current of electricity sustained in it longitudinally will cause evolution of heat at one side and absorption of heat at the opposite side all along the bar, when the whole substance is kept at one temperature. The author has found this effect in Bi, Zn, Sn and Cd. The effect is by far the largest in Bi. The experiments were made on single crystal bars of approximately 10 cm. length and 6 cm. diameter. In bismuth, with currents of the order of 1 amp., thermal e.m.f.'s of the order of 15×10^{-4} volts were found, corresponding to a temperature difference between the two sides of the bar of 0·4° C. In Zn, Cd and Sn the effect is about 500 times smaller. It appears that the precise way in which the transverse heat varies with the inclination of the bar to the crystal axis is determined by the way in which the current-carrying electrons are distributed about the crystal axes. J. J. S.

2136. *Accidental Thermoelectric Currents in Bismuth.* **G. Todesco.** (N. Cimento, 4. pp. 94–103, Feb., 1927. Accad. Lincei, Atti, 5. pp. 434–438, March 20, 1927.)—Continuing Majorana's researches [see Abstract 2695 (1926)], the author made the following experiment: The bismuth ring is suspended by a metallic torsion thread between the poles of a permanent magnet, its maximum dimension parallel to the lines of force. The movable system carries a mirror for reading the deviations and a liquid damper. When the light from an electric lamp of 100 candles is concentrated on a point in the periphery of the ring a marked deviation is observed. A permanent magnet was chosen because in the intense field of an electromagnet the special phenomenon to be examined might be masked by the diamagnetism of the bismuth and by other thermomagnetic effects, *e.g.*, the Corbino effect. Antimony, cadmium, tin and zinc gave a like effect, the intensity of the thermoelectric current being in the order Bi, Sb, Cd, Zn, Sn. On passing the light over the periphery of the ring, certain regions are found which give deviations in each direction and intermediate regions where the deviation is zero. The distribution of these regions varies from one sample to another. Further experiments appear to justify the hypothesis that the structural dissymmetries causing accidental thermoelectricity in bismuth are due to variations in the orientation of the crystals formed after fusion, which confirms Majorana's conclusions. E. F.

2137. *The Influence of Standing Waves in Thin Films on the Strength of the Photo-Current.* **N. Akulov.** (Zeits. f. Physik, 41. 11–12. pp. 920–926, 1927.)—Studies mathematically the effect produced by standing waves in a photoactive plane parallel film separating two media, and shows that if the reflecting power of the boundary of the second medium (that on the emergent side of the film) differs from zero, the standing waves produced in the film may cause the strength of the photo-current to vary periodically with the film thickness. The equation derived is made use of in explaining the observations of Predwoditelew and Netchaewa [see Abstract 663 (1925)], who employed films of fuchsin on silver with a quartz mercury lamp. The periodic effects due to the two effective lines given out by the lamp are determined and combined graphically, the resulting curve agreeing well with the observations. The measurements of Stuhlman [see Abstract 2449 (1922)] on thin metal foils are also considered. H. N. A.

2138. *The Case "Thalofide Cell."* **J. Kaplan.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 251–256, March, 1927.)—A very sensitive cell was made by T. W. Case by using fused thallium sulphide, which changes resistance under the influence of light. The sensitivity of this cell, called the "thalofide cell," was studied between wave-lengths 5000 Å. and 12,000 Å. At 1μ the cell was found to be four times as sensitive as a Hilger thermopile, or eight times as sensitive if the absorption of the glass screen used is taken into account. With small intensities of light, the response of the cell was quick and steady, and thus the cell is specially good for spectrophotometry. The thalofide cell arrangement was tested in its best spectral region by investigating the absorption band of liquid water at 1μ. The arrangement was about sixty times as sensitive as the Hilger thermopile. J. J. S.

2139. *Dielectric Constants of Electrolytes.* **H. Sack.** (Phys. Zeits. 28. pp. 199–210, March 1, 1927.)—An account is given of the experimental determination of the dielectric constants of various electrolytic solutions of small concentrations by means of a modification of the Nernst bridge with high-frequency currents. The theoretical discussion already partly given in the author's previous paper [see Abstract 1654 (1926)] is continued. J. J. S.

2140. *Significance of the Dielectric Constant of a Mixture.* **H. H. Lowry.** (Frank. Inst., J. 203. pp. 413–439, March, 1927.)—A review of the literature shows that the dielectric constant of a mixture is rarely additive. Even the equation $\frac{\epsilon - 1}{\epsilon + 2} \cdot \frac{1}{d} =$ constant, which has been derived independently by six investigators and undoubtedly has a greater theoretical significance than any other yet suggested, gives for pure liquids deviations well outside the limits of the experimental error. The above formula and all other formulæ which have been derived for the calculation of the dielectric constant of a mixture include the two related assumptions: (1) that the capacities are directly additive, and (2) that the molecules of the components are without mutual dielectric influence. Simple consideration of the dipolar nature of most molecules indicates that such assumptions are probably not justified, and, moreover, the agreement between the observed values of the dielectric constants of mixtures and those calculated in accordance with these assumptions is best when both components have low dielectric constants—that is, small dipolar moments. The data on the dipolar moments of the molecules are as yet insufficient to allow of the quantitative prediction of the effect on the dielectric constant of adding one substance to another. T. H. P.

2141. *Dielectric Power Losses at High Frequencies.* **G. E. Owen.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 725–726, Dec. 1, 1926). —Calorimetric method for studying the losses in insulating materials at high frequencies; an effort to avoid those losses which necessarily occur in an electric measuring system. A. D.

2142. *The Theory of Brownian Motions for Systems in which there are Different Temperatures.* **L. S. Ornstein.** (Zeits. f. Physik, 41. 11–12. pp. 848–856, 1927.)—Ising has shown that the limit to the sensitiveness of a galvanometer depends on Brownian movements [see Abstract 1909 (1926)], and the author deals with the case in which the galvanometer and the rest of the circuit are at different temperatures. He commences by giving a method of calculating the mean energy of the Brownian motion of a colloidal particle already published by him, and then develops a similar mathematical method for the present problem, assuming in addition to fortuitous collisions fortuitous e.m.f.'s in the two parts of the circuit which are at different temperatures. H. N. A.

2143. *Measurement of High Potentials.* **R. Gunn.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 257–262, March, 1927.)—Two methods of measuring potentials of the order of 100,000 volts are described which make use of ordinary laboratory instruments. The first method is a potentiometer method, using a 1500-volt generator with standard voltmeter as the "standard cell." The second method is a voltmeter method using a precision shunt across the indicating galvanometer. The high resistances required were made up of water, which was made to circulate continuously through long uniform glass tubes. This type of resistance with an "effective zero temperature coefficient" is described, and its use for the measurement of high potentials is discussed. Experimental comparison of the two methods gave good agreement within 1 %. The methods are of particular value when the power source is a small one. J. J. S.

ALTERNATING CURRENTS AND MAGNETISM.

2144. *Inductances of Coils.* **H. Nagaoka** and **S. Sakurai.** (Imp. Acad. Tôkyô, Proc. 3. pp. 19–22, Jan., 1927.)—Formulæ are quoted from which have been compiled tables giving the self-inductances of circular coils, the mutual inductances of pairs of such coils, and the mechanical forces between pairs, for very small steps in the ratio of length to radius. These will shortly be published. G. A. S.

2145. *Distribution of Foucault Currents in a Metal Disc under the Action of an Inductor Pole of Circular Section but Eccentric Relative to the Disc.* **Barbillion.** (Comptes Rendus, 184. pp. 871–872, April 4, 1927.)—The usual theory deals with the case of the circular inductor pole concentric with the metal disc, but in the present case the pole and disc are eccentric. Mathematical. A. B. W.

2146. *Initial and Maximum Permeability.* **J. Würschmidt.** (Phys. Zeits. 28. pp. 210–211, March 1, 1927.)—Referring to Vogel's statement [see Abstract 223 (1927)] that small initial permeability (I.P.) is associated with high coercive force and low maximum induction, the author draws attention to some conclusions recently published by him on this subject [see Abstract 967 (1923)], *viz.*, (1) small maximum permeability (M.P.) accompanies small I.P.; (2) I.P. is low when coercive force is high and remanence is low; (3) high M.P. is not always found with high I.P.; (4) annealing increases I.P. in the majority of cases; (5) I.P. is considerably increased by the addition of silicon. The validity of Gumlich's rule is discussed. G. E. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY

2147. *Neuromuscular Excitation in Man by Progressive Currents.* **P. Fabre.** (Comptes Rendus, 184. pp. 699–701, March 14, 1927.)—Defines a "linear constant of excitation" obtained by dividing the threshold voltage by the limiting rate of growth of the electromotive force used. Experimental arrangements and results are given. W. V. M.

2148. *Radiation Shock.* **J. Risler** and **F. de Courmelles.** (Comptes Rendus, 184. pp. 701–703, March 14, 1927.)—It is shown that the rapidity with which mice, injected with methyl violet, succumb to exposure to radiation increases with the frequency of the radiation employed and the intensity of the light. W. V. M.

2149. *X-Ray Quality Meter.* **I. Solomon.** (Comptes Rendus, 184. pp. 872–875, April 4, 1927.)—A brief description is given of a direct and continuously indicating instrument for the "quality" measurement of X-rays. Two ionisation vessels and a four-electrode (two grids) valve are used, and variation of plate current indicated on a microammeter. A. B. W.

2150. *Absorption of X- and γ-Radiations and the Secondary Radiations which accompany them.* **de Broglie.** (Brit. J. of Radiology, 23. pp. 55–62, April, 1927.)—A discussion of some of the problems involved in the physical basis of the action of high-frequency radiations on living tissues. The distinction between absorption by fluorescence and by diffusion may be of fundamental biological significance. The results obtained when the wave-length of the X-rays used to ionise the gas in a Wilson cloud-track apparatus is decreased are described, and it is pointed out that similar circumstances must arise in liquids and solids, with the difference that the tracks must be much shorter in these media. The biological action is then to be interpreted as the action of secondary β-rays, the heavy atoms present in small quantities being perhaps of great importance, while the differences in the action of hard and soft X-rays may be due to the differences in type of electron (fluorescence or "recoil") liberated. For γ-rays (discussed in the last section of the lecture) the recoil electrons are all-important. Recent work seems to indicate that a trigger action may also occur, atoms which are not actually ionised being brought into a kind of "excited" state. The answer to the problem is, however, still obscure. W. V. M.

2151. *International Standardisation of Measures in Röntgentherapy.* **A. Béclère.** (Brit. J. of Radiology, 23. pp. 66–72, April, 1927.)—The paper commences with an historical review of the measurement of quantity and quality of X-ray beams, and eventually quotes the results of Grebe and Martius, who showed that the "unit skin dose" varied by some 400 % in various continental clinics. A physical and not biological unit is obviously necessary. The R unit of Solomon is recommended as being suitable and the Behnken unit (also called an R unit) considered as difficult to obtain experimentally. It is stated that 1 Behnken's R = 2·25 Solomon's R. The author puts in a plea for an international agreement on the subject. W. V. M.

2152. *Radiological Units in Dosimetry.* **A. E. Dauvillier.** (Brit. J. of Radiology, 23. pp. 83–88, April, 1927.)—Radiological units must possess a universal character susceptible of adoption by international agreement, and should be intimately related to the c.g.s. system. Quality may be defined for medical purposes as effective wave-length—for example, as suggested by Duane in terms of Al and Cu transmission. The author shows how the energy of the beam may be measured in ergs, the unit of power being expressed as "the energy, expressed in ergs per second, absorbed in unit time in a cubic centimetre of water contained in an indefinitely extended medium," and the total dose as "the energy, expressed in ergs absorbed in a cubic centremetre of water contained in an indefinitely extended medium." The construction of a standard chamber is described, by means of which all measuring instruments may be calibrated. It is shown that W, the power of the radiation, is equal to $28 \cdot 7 \times 10^{10}\ i/v$ ergs/sec./cm.^{3} water, where i is the ionisation current in amperes and v the effective volume of gas (air) at N.T.P. The author's xenon exploring chamber is thus calibrated in absolute units, and it becomes possible to compare in a precise way the action of γ-rays, X-rays, and ultra-violet rays. W. V. M.

2153. *The Problem of Measuring X-Rays.* **H. Moore.** (Brit. J. of Radiology, 23. pp. 88–92, April, 1927.)—The author discusses methods of measuring the quality and quantity of an X-ray beam and the difficulties inherent in such a measurement. It is considered that the ionisation spectrometer is the ideal instrument for use in radiology, but no suitable instrument is at present available, and hence the most practicable method of standardisation would be the use of constant-voltage high-tension generators, the intensity being thus defined in terms of the secondary current, voltage and nature of the target of the tube. Finally, the author re-emphasises the necessity of eventual spectro-intensimeter measurements. W. V. M.

2154. *Further Researches on Intensity Distribution in Irradiated Media.* **F. Dessauer and B. Rayewsky.** (Brit. J. of Radiology, 23. pp. 92–96, April, 1927.)—A brief *résumé* of the controversy concerning the measurement of X-ray intensity by either photographic or ionometric methods. The errors of the latter are insisted upon, and the early results of Dessauer defended as compared with those of Holfelder. The fall of intensity in the first few centimetres observed by Dessauer is shown to be due to experimental conditions, and that the intensity in the scattered ray zone has been in general over-estimated. The unsuitability of the ionisation method for standard measurements is shown unless the chamber construction is standardised, and the authors determine to keep to the photographic method in these measurements. W. V. M.

2155. *Effects of X-Rays in Various Reactions.* **G. L. Clark.** (Brit. J. of Radiology, 23. pp. 112–124, April, 1927.)—Whilst various chemical reactions induced by X-radiation are well known, experimental evidence of the nature and extent of induced chemical reactions is fragmentary. Recent work is that of Bayley on the coloration of alkali halides, that of Chamberlain on the dependence upon valency, and of Grube and Baumeister on anodically polarised electrodes used for photolysis. The present author has investigated the effects of X-radiation in three chemical reactions. Firstly, in the oxidation of benzaldehyde and rubber he finds, whilst a photochemical reaction occurs with visible and ultra-violet radiation, X-radiation has little effect. Secondly, the experiments of Schwarz and Klingenfuss are repeated [see Abstract 984 (1923)] on the action of X-radiation in the platinum contact process of sulphuric acid manufacture. These prior investigations are confirmed. It is further found that the effect of radiation is very dependent on the amount of water vapour present. Thirdly, an electron absorption theory, due to Wendt and Grimm, of the action of "knock" reducing agents (as lead tetraethyl) in internal combustion engines is investigated when X-radiation is used as an ionising agent. The experiments prove this theory to be untenable. B. J. L.

2156. *Selective Chemical Action of X-Rays and Light.* **L. Simons.** (Brit. J. of Radiology, 23. pp. 124–134, April, 1927.)—A somewhat general paper on the physical mechanisms of reactions invoked by radiations. The biological aspects are briefly mentioned. A "heat-point" theory of the action of radiation is developed and a theory that the action of radiation has a trigger-like action in causing conductive paths in the otherwise non-conductive cell. B. J. L.

2157. *New Metal X-Ray Tubes for Radiography and Therapeutics.* **A. Bouwers.** (Brit. J. of Radiology, 23. pp. 139–143, April, 1927.)—Modifications of a metal X-ray tube (Metallix) for medical purposes are described. This is of the electron type in which the filament-target distance is small. The advantages of a conical focus are described. The tube employs chrome-iron and glass seals. Tubes are manufactured for 220 kV. B. J. L.

2158. *A New Potter-Bucky Diaphragm.* **J. Koopman.** (Brit. J. of Radiology, 23. pp. 144–149, April, 1927.)—The original Potter-Bucky dashpot actuated grid is well known. Heilbron has used an electrical motor drive and van Tengbergen a pendulum drive. The requirements for absence of grid lines with the latter are considered. It is shown that grid lines are not produced with a sufficiently lengthy exposure, or a more rapid grid movement, dependent on the mass of the pendulum counterweight. B. J. L.

2159. *X-Ray Protective Measures.* **G. W. C. Kaye.** (Brit. J. of Radiology, 23. pp. 155–163, April, 1927.)—After a preliminary account of early attempts to define efficient protection, the author considers "some of the main points which have been brought home to" the National Physical Laboratory. The paper contains useful tables of lead equivalents for various materials used in normal protective construction, and it is shown that this equivalent for such materials as barium sulphate bricks pass through pronounced maxima when the voltage is varied. Ventilation and electrical precautions are also considered. The paper concludes with a plea for international cooperation in the matter of X-ray protection, and quotes the recommendations of committees in America, Norway and Russia respectively. W. V. M.

2160. *Protection in Radiotherapy.* **H. Pilon.** (Brit. J. of Radiology, 23. pp. 164–168; Disc., 168–170, April, 1927.)—The paper consists largely of a description of an oil-immersed Coolidge tube in a lead case suitable up to 250 kV. The tube is cooled by an oil circulation, the coil being itself cooled by a water-cooling device. The arrangement may also be employed with air-cooled tubes. In the *Discussion,* **E. A. Owen** remarked that the value of the apparent absorption would vary with voltage owing to the discontinuity for lead at 85 kV. The Philips metal tube appeared to be a step in the right direction from the standpoint of protection. **Glasser** emphasised the importance of knowing in some standard unit the amount of radiation permissible per annum. **Pullin** gave details of trouble arising from faulty protection. **Moore** mentioned the difficulties in protection from γ-rays. W. V. M.

2161. *Organisation of Hospital Radium Service.* **F. L. Hopwood.** (Brit. J. of Radiology, 23. pp. 170–178; Disc., 179–181, April, 1927.)—A discussion of some important points in the organisation of the radium service in a large general hospital. It includes a description of a number of devices facilitating radium manipulation, and detail of a radium safe, protective devices, and such matters as requisition forms, etc., required to safeguard against loss. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2162. *Adsorption from the Vapour Phase at a Liquid-Vapour Interface.* **L. I. A. Michell.** (Phil. Mag. 3. pp. 895–911, April, 1927.)—The adsorption from the vapour phase at the liquid-vapour interface was studied by a specially designed drop-weight apparatus. The drop was allowed to form in an atmosphere of the vapour at constant temperature, slowly allowed to detach from the tube, and the weight of the drop determined. It was found that when adsorbed at a water-air interface, benzene and the paraffin hydrocarbons form unsaturated unimolecular layers. The paraffin hydrocarbon molecules are probably orientated on end—that is, with a CH_3 group directed towards the water surface. Mercury behaved similarly, but closely packed layers are formed. The difference in behaviour is probably due in part to the difference of volatility of mercury and water. The heat of adsorption at a water-air interface was calculated and found to be 12 kg.-calories. F. J. B.

2163. *Chain Formation of Emulsoid Particles in an Alternating Field.* **E. Muth.** (Kolloid Zeits. 41. pp. 97–102, Feb., 1927.)—Emulsions of milk, butter-fat and petroleum-water are placed in capillary tubes fitted with wire electrodes and mounted on the stage of a microscope giving a magnification of 1500 diameters. On applying an alternating potential of high frequency by means of an oscillating valve circuit the emulsoid particles gradually attach themselves in line to give a straight chain in the direction of the field and assume the appearance of a string of beads. The phenomenon is similar to that previously observed by Thomson in the vapour from arcs when submitted to a magnetic field. [See Abstracts 1564 and 1751 (1921).] Illustrations are given of types of double and multiple chains observed. Cataphoretic movement of the chains in one direction is also observed. An explanation of the phenomenon is given on the basis of the electrical double-layer theory. In accordance with the explanation put forward, a potential gradient of a certain threshold value is required to produce the phenomenon. The frequency of the field on varying from 2×10^4 to 2×10^6 cycles is without effect on the nature of the chain formation. [See also Abstract 1678 (1926).] J. N. P.

2164. *Solutions for Colorimetric Standards. Part I. Spectral Transmission Curves for Some Aqueous Solutions Containing Organic Indicators or Inorganic Salts.* **M. G. Mellon** and **F. D. Martin.** (J. Phys. Chem. 31. pp. 161–177, Feb., 1927.)—Spectro-photometric measurements are made on systems containing indicators proposed by Clark and Lubs for the determination of H-ion concentration and the inorganic solutions suggested by Arny and others for general colorimetric work. The results are expressed in curves, which are plotted with wave-lengths as abscissæ on an ordinary scale and percentage transmittancy as ordinates on a logarithmic scale. The data represented furnish a check on the minimum point of the curves obtained by Brode, and include, in addition to data for Arny's solutions of organic salts, data for the same indicators at other concentrations, and for a number of other indicators, including four of those recently proposed by Cohen. A. B. C. L.

2165. *Continuity of the Electric Structure of the Colloidal Particle, Ion, Electron and Sub-Electron.* **S. N. Ray.** (Kolloid Zeits. 41. pp. 193–196, March, 1927.)—Yang has shown that when ultra-violet radiation falls upon ultra-microscopic particles of diameter a, the ratio e/a (where e is the saturation charge) is constant, and that the saturation charge grows with the diameter from zero value upward. That would account for Ehrenhaft's sub-electronic charges and would also be in agreement with the author's unpublished observation that for photophoresis in liquids all particles have practically the same velocity. For colloids the e/a is constant, in liquid as well as in gaseous media. The e/a taken from Burton's table (Physical Properties of Colloidal Solutions) differ widely for different substances, but the ratio $e/a : v$ has practically the constant value 1·4, v being the kataphoretic velocity of Helmholtz. This relation is discussed with respect to Smoluchowski's somewhat divergent views. H. B.

2166. *Colloidal Zinc.* **W. Engelhardt.** (Kolloid Zeits. 41. pp. 234–242, March, 1927.)—Colloidal zinc sols are prepared by forming an arc between the ends of two obliquely-inclined zinc rods which are immersed in water. A potential source of 220 volts is employed and a current of 2·5–3 amperes with an arc voltage of 25–30 volts. With increasing temperature the proportion of coagulated metal diminishes, and at 90°–95° C. the sol remains completely dispersed. In boiling water the greater part of the colloid decomposes to oxide. Analyses are made of the free metal and the proportion oxidised. The influence is determined of the magnitude of the current potential and distance of separation of the electrodes on the proportion of dispersed metal. The presence of protective colloids such as starch, gelatine, saponin, and agar do not increase the yield of colloidal metal, but, if added after the formation of the sol, has a retarding effect on the rate of oxidation of the metal and on the coagulation of the sol on standing. The protective action of starch is sufficiently marked to peptise the coagulated sol when in warm water. Dilute metal sols decompose more rapidly than the concentrated sols. Electrophoresis measurements show the colloid to have a positive charge. The oxide appears to surround the particles of zinc as a film, increasing their positive charge and enhancing the stability of the sol. The metal cannot be separated from the oxide by electrophoresis. The viscosity of the sol is found to be not appreciably higher than that of the dispersion medium. On shaking the sols with organic liquids, a separation of the suspensoid occurs at the boundary of the two liquids or else a black slime is formed. J. N. P.

2167. *Apparent Viscosity of Colloidal Solutions.* **E. Hatschek.** (J. Phys. Chem. 31. pp. 383–392, March, 1927.)—Discussion of the available results leads to the conclusion that no direct evidence exists of the formation of ramifying aggregates in viscous sols, on the structure of which the ultramicroscope gives little information. There is, however, ultramicroscopic evidence that high viscosity and even gelation may be exhibited by a sol without aggregation or even mutual approach of the particles. Sorption experiments furnish no information concerning the degree of hydration in true or colloidal solution and its variation with concentration. Consideration of the amounts of liquid taken up by gelatine or rubber during swelling shows that the volumes of disperse phase postulated by the author's formula are not impossible or even improbable. Investigation of the behaviour of rubber in various solvents indicates that solvents in which rubber swells the more produce the more viscous sols, in strict accordance with the author's assumptions and in quantitative agreement with his formula. If the viscosity of a given sol varies with the shear gradient, single measurements at arbitrary and unknown shear gradients are of no theoretical value, least of all as a foundation for hypotheses regarding structure. T. H. P.

2168. *Partial Molal Volumes of Water and Salt in Solutions of the Alkali Halides.* **V. K. Lamer and T. H. Gronwall.** (J. Phys. Chem. 31. pp. 393–406, March, 1927.)—A rapid analytical method for the calculation of the partial molal volumes of salt and of solvent from density determinations is described. Values for the partial molal volumes of water and of salt at 0°, 25° and 50° C. are calculated for the fifteen alkali chlorides, bromides and iodides by the use of a fourth degree equation to represent the density data of Baxter and Wallace. The effects on the final results of errors in the original data are discussed. There are strong indications that the density data for KCl at 0°, 25° and 50° C. and for RbCl and CsI at 0° C. may be sufficiently in error to account for certain irregular results. The values for the other salts are consistent with one another. On the basis of this agreement, and on the principle of the additivity of the properties at infinite dilution, adjustment in the limiting values for KCl, RbCl and CsI is made. The bearing of the results, and particularly the effect of temperature, is discussed in the light of T. J. Webb's theory. The position of the NH_4^+ ion in the alkali series is interpreted on the basis of its partial molal volume. A. B. C. L.

2169. *Diffusion of Aqueous Sodium Silicate Solutions across Semipermeable Membranes.* **P. B. Ganguly.** (J. Phys. Chem. 31. pp. 410–416, March, 1927.)—Experimental investigation is made of the diffusion across membranes of aqueous sodium silicate solutions, using both parchment and collodion membranes. Analysis of the solutions obtained after the establishment of equilibrium shows that the SiO_2 concentration in the original silicate compartment is generally greater than that in the other compartment. The distribution is greatly dependent on the original molar ratios of the solutions. Solutions up to the molar ratio 3·0 show very little variation in concentration during diffusion, showing that the quantity of non-diffusible matter in such solutions is comparatively small. With higher ratios the quantity of non-diffusible matters increases very rapidly, this result being in agreement with previous measurements of the scattering of light by silicate solutions, and showing conclusively that beyond the ratio 3·0 the proportion of colloidal material in the silicate solutions increases rapidly. The amount of Na left in the silicate compartments is also greater than that found in the water compartment, which is taken as indicating that the colloidal material present in the higher ratio silicate solutions is in the form of molecular aggregates or ionic complexes containing both Na and SiO_2. Osmotic pressure measurements are made which support this conclusion. Measurements of *p*H of the solutions after equilibrium is established show that hydrolysis does not take any prominent part during the distribution processes. A. B. C. L.

2170. *Experimental Contributions to the Subject of Diffusion in Solutions.* **E. Ullmann.** (Zeits. f. Physik, 41. 4–5. pp. 301–317, 1927.)—Uses a modification of a method described by Fürth [see Abstract 431 (1926)], in which, by using a very small observation space and observing the diffusion of coloured liquids by means of a microscope, the time of a series of observations can be cut down from several days to from ten to twenty minutes. The rate at which a given concentration c spread was determined, and in agreement with Fürth it was found that the relation between x the distance and $\sqrt{t}$ is linear for small concentrations, where t is the time. It is shown that under the conditions of the experiments this implies the correctness of Fick's law of diffusion in this case. Some experiments were made on colloid solutions of dyestuffs, the diffusion coefficients being determined and the size of the particles calculated from them; this size was found to increase with the concentration. A crystalloid solution ($KMnO_4$) was also used, and D was found to diminish with the concentration, the value obtained for zero concentration being $15 \cdot 2 \times 10^{-6}$. The value calculated by Nernst's theory from the known mobilities of the K and MnO_4 ions and the osmotic pressure for 1-gramme molecule per c.c. is $D = 15 \cdot 9 \times 10^{-6}$. Experiments were also made with coloured solutions of very high concentration in order to arrive at the relation between the diffusion current Q and the concentration gradient. The deviations from Fick's law are considered in the light of the theories of Nernst, Einstein and Smoluchowski.

H. N. A.

2171. *Action of Complex Salt Solutions on Ferrous Metals.* **R. Girard.** (Comptes Rendus, 184. pp. 818–820, March 28, 1927.)—Experiments are described on the action on steel and cast iron of a solution containing, in grammes per litre: sodium chloride, 20; magnesium chloride, 3; magnesium sulphate, 1·75; calcium sulphate, 1·8. The experiments, continued for 300 days, confirm the tendency of cast iron to rust and that of steel to corrode. [See Abstract 2725 (1926).] With a complex mixture of salts, the total effect is shown, not in the attack, but in the texture of the corrosion products. Calcium sulphate (a precipitant in both aerated and non-aerated solutions), sodium chloride (precipitant in aerated and corrosive in non-aerated solutions), and magnesium salts (always corrosive) combine their effects to produce greater or less porosity of the precipitates.

T. H. P.

2172. *Soret Effect. Part I.* **C. C. Tanner.** (Faraday Soc., Trans. 23. pp. 75–95; Disc., 95, March, 1927.)—An optical method, now described, for studying the Soret effect gives for fairly concentrated solutions of electrolytes results in substantial agreement with the most reliable ones of previous investigators. In particular, certain of Chipman's results [see Abstract 813 (1927)] are confirmed. The magnitude of the fractional change of concentration per degree found by the optical method is, however, always numerically greater than that found by the conductivity method.

T. H. P

2173. *Submerged Corrosion of Metals.* **O. B. J. Fraser, D. E. Ackerman** and **J. W. Sands.** (Indust. and Engin. Chem. 19. pp. 332–338, March, 1927.)—In measurements of the rate of corrosion of Monel metal by sulphuric acid solutions, determinations are made of the influence on the rate of corrosion of the main determining factors and the conditions are ascertained to enable reproducible tests to be conducted. The corrosion rate, at constant temperature, varies continuously with the concentrations of hydrogen ion and dissolved oxygen in solutions of from 0 to 80 % sulphuric acid by weight. With higher acid concentrations the rate is also a continuous but different function of the concentration. At the lower acid concentrations the reaction results in the formation of metal sulphates alone, while, at the higher concentrations, sulphides are formed in addition. In dilute sulphuric acid the corrosion rate, at constant temperature, is directly proportional to the oxygen concentration reaching a maximum, therefore, when the solution is saturated with it. Consequently the most effective means for controlling this variable is to maintain the solution at saturation with respect to air. The corrosion rate increases continuously with the velocity of relative movement between the test piece and the solution. The rate of change of corrosion rate diminishes as the velocity increases, and approaches constancy at a velocity of about 200 ft. per min. High test velocities are consequently desirable so that the effect of variations in velocity during the time of test will be minimised. J. N. P.

2174. *Transformations in Rose's Metal.* **R. Fleischmann.** (Zeits. f. Physik, 41. 1. pp. 8–17, Jan., 1927.)—Rose's metal appears to possess three modifications, called here σ, α and β. σ is the newly solidified metal; it transforms to α about 60° on cooling. When reheated α transforms to β at about 76°. After this, β is stable above 76° and α below 76°. σ can only be recovered by melting and solidifying once more. α and β were investigated by making volume and resistance measurements, and the dependence of the transformation-velocity on temperature was determined. Thermoelectric observations confirmed the results. A. C. M.

2175. *Potential of Aluminium.* **P. Drossbach.** (Zeits. Elektrochem. 33. pp. 114–117, March, 1927.)—The theoretical potential of aluminium was developed from the reaction $4Al + 3O_2 \rightleftarrows 2Al_2O_3 + 760{,}400$ cal., and from the specific heats of the reacting elements. The thermodynamics of the system were developed, and from published data an expression was obtained for the potential of aluminium, which gave the value $\epsilon_{Al} = -1\cdot33 \pm 0\cdot01$ volt, a value which differs considerably from that obtained by Neumann and Richter, *viz.*, $-0\cdot845$ volt, and the difference is too great to be explained by the error in the sum of the specific heats. F. J. B.

2176. *Determination of the Energy in Photochemical Action.* **R. Audubert.** (Comptes Rendus, 184. pp. 881–883, April 4, 1927.)—The threshold frequencies of ultra-violet light which bring about the reaction $2Fe^{++} + 2H^{+} + 2h\nu \rightleftharpoons 2Fe^{+++} + H_2 + 2h\nu$ are determined by measuring the e.m.f. produced when one of two connected platinum electrodes, immersed in a solution of a ferrous or a ferric salt, is exposed to illumination of various frequencies. The e.m.f. depends on the solution pH and increases with time of exposure, tending towards a steady value which is more rapidly attained with ferrous than with ferric salts. From the formula $Q = Nh(\nu_0' - \nu_0)$, where $\nu_0' = 3\cdot5 \times 10^{14}$ and $\nu_0 = 2\cdot0 \times 10^{14}$ are the threshold frequencies for ferrous and ferric ions respectively, $Q = -30{,}000$ cal. Q determined by observations on the cell

$$Pt \,\Big|\, \substack{\text{acid}\\ \text{solution}} \,\Big|\, \substack{\text{KCl}\\ \text{solution}} \,\Big|\, \substack{\text{ferrous}\\ \text{solution}} \,\Big|\, Pt$$

is $-29{,}700$ cal., in close agreement with the value derived from the photochemical measurements. The energy change in oxidation of ferrous ions to ferric ions by oxygen is derived by adding the heat of formation of water to Q when the value + 39,400 cal. is obtained, in agreement with the results of thermochemical measurements. L. M. C.

2177. *Question of the Existence of Tervalent Hydrogen.* **F. Paneth, E. Klever** and **K. Peters.** (Zeits. Elektrochem. 33. pp. 102–107, March, 1927.)—A number of experiments on the diffusion of hydrogen through a glowing palladium capillary, the passage of the gas over a heated Nernst glower or tungsten wire, the decomposition of acids by magnesium, the explosion of detonating gas, the treatment of hydrogen in an ozoniser, and the action of α-rays on hydrogen are described, but the only indication of the existence of tervalent hydrogen is the observation of the particle H_3^+ in a canal-ray tube. The value 3·024 found by Aston for the mass of this particle renders it virtually certain that the particle consists of three hydrogen atoms with a positive charge and not of any heavier atom with a greater number of positive charges. In contradiction to J. J. Thomson's view, the appearance of H_3^+ depends not on the previous treatment of the hydrogen, but on the discharge conditions of the canal-ray experiment. Thomson's views on the stability of H_3 are also open to criticism. It is conceivable that H_3^+ is stable for some time, but the uncharged H_3 is incapable of existence. [See Abstract 615 (1925).] T. H. P.

2178. *Photosensitised Decompositions by Emitted Mercury Atoms.* **H. S. Taylor** and **J. R. Bates.** (Nat. Acad. Sci., Proc. 12. pp. 714–717, Dec., 1926.)—The rôle of excited mercury atoms in a number of photosensitised decomposition processes has been studied. It has been shown that water, ammonia, ethylene, methyl and ethyl alcohols, hexane and benzine, acetone, formic acid and ethylamine are all sensitised to the wave length $\lambda = 2536 \cdot 7$ Å.U. through the agency of excited mercury. In all cases decomposition of the molecule occurs. Particular attention is drawn to the decomposition of ammonia, the gases from which show marked excess of hydrogen, pointing to the decomposition by stages, probably through hydrazine. A. B. W.

2179. *Velocity of Chemical Reaction in the Silent Electric Discharge.* **G. A. Elliott, S. S. Joshi** and **R. W. Lunt.** (Faraday Soc., Trans. 23. pp. 57–60, March, 1927.)—An expression is developed connecting the velocity of chemical reactions in silent electric discharges to the gaseous pressure and to the electrical factors determining the charge, which may be written:

$$\frac{kV_0}{E} = \frac{1}{p}\left(\log\frac{k}{e} + \log i - \log\frac{K}{p}\right),$$

where V_0 = critical energy,
E = strength of electrical field,
p = pressure,
e = ionic charge,
i = current per square cm.,
K = velocity of reaction,
k = constant.

This relation is confirmed by experimental observations, which show that, if E is constant, $\log\frac{K}{p}$ and p are linearly related. B. W. C.

2180. *The Activation of Hydrogen in the Electric Discharge.* **G. A. Elliott.** (Faraday Soc., Trans. 23. pp. 60–73; Disc., 73–75, March, 1927.)—Active hydrogen is produced by subjecting pure hydrogen to a high-frequency electric discharge in a Siemens ozoniser tube, the active hydrogen being detected by its reaction with sulphur to form sulphuretted hydrogen. The variation of the yield with the rate of flow of the hydrogen, with the voltage at different pressures and with the frequency of the discharge, was determined. By making use of the equation developed in the former paper [see preceding Abstract], the critical energy V_0 of activation of the hydrogen molecule was evaluated. B. W. C.

2181. *Catalytic Combustion. Part V. Union of Carbonic Oxide and Other Gases with Oxygen in Contact with a Fireclay Surface at 500° C.* **W. A. Bone** and **A. Forshaw.** (Roy. Soc., Proc. 114. pp. 169–180, March 1, 1927.)—Experimental results are given showing that a fireclay surface at 500° C. catalyses the combination of (moist) carbonic oxide and oxygen much in the same way as it does that of hydrogen and oxygen at the same temperature, but to a less degree. With a moist mixture of carbonic oxide and oxygen in their combining proportions, the rate of combination is always directly proportional to the pressure of the dry mixture, provided that the surface is in a normal condition and that the reaction product is quickly removed from the system. The catalysing power of the surface may be greatly stimulated by previous exposure to the combustible gas at the reaction temperature, but such stimulus is not permanent and gradually dies away after the exciting cause is removed. The effect may be removed also by exposing the surface to oxygen at the reaction temperature, an oxygen-treated surface becoming either normally active or only slightly more so, according to the conditions. When the carbonic oxide and oxygen are present in other than their combining proportions, their rate of combination is proportional to the partial pressure of the carbonic oxide, this being then the controlling factor in the process. Hydrogen is more amenable to catalytic combustion than carbonic oxide, and the latter than methane. [See Abstract 510 (1927).] T. H. P.

2182. *Experiments to Test the Possibility of Transmutation by Electronic Bombardment.* **M. W. Garrett.** (Roy. Soc., Proc. 114. pp. 289–292, March 1, 1927.)—In an earlier paper [see Abstract 507 (1927)] experiments were described recording the failure to transmute mercury into gold, and aborptive attempts are now published for transmuting tin into indium in a quartz apparatus similar to that used for mercury, and also in the apparatus wherein Smits reports evidence of the formation of thallium and mercury from lead. These failures occurred notwithstanding the employment of high current densities and an extraordinarily sensitive spectroscopic method. Indium was detected in all the samples of pure tin examined, and the 4102 line was found to be the most persistent in the spectrum of this element. Attempts were also made to prepare scandium from titanium, using electrons of sufficient speed to be certain of penetrating the K ring of this element, but without any evidence of transmutation being obtained. H. H. Ho.

2183. *Electrometric Study of the Precipitation of Phosphates.* **H. T. S. Britton.** (Chem. Soc., J. pp. 614–630, March, 1927.)—Phosphoric acid behaves in its successive stages of ionisation as a strong acid, a weak acid, and an extremely weak acid, the hydrogen-electrode titration curve of the acid by sodium hydroxide being satisfied by the dissociation constants $K_1 = 0 \cdot 94 \times 10^{-2}$, $K_2 = 1 \cdot 4 \times 10^{-7}$, and $K_3 = 2 \cdot 7 \times 10^{-12}$ at 20°. The curves for neutralisation of the acid by the alkaline earths show that, at first, this process proceeds beyond the limits fixed by the very small solubilities of the alkaline earth phosphates, which later became precipitated, although a considerable time must elapse before equilibrium between the precipitates and the solutions is established. The presence of sucrose in a phosphoric acid solution prevents the exceptional increase in hydrogen-ion concentration which ordinarily occurs during precipitation with calcium hydroxide. Calculation from Bassett's data (Chem. Soc., J. p. 620, 1917) shows that at 25° calcium phosphate is not precipitated from solutions more acid than pH 5·5. Hydrogen-electrode titrations with trisodium phosphate of salt solutions of zirconium, thorium, aluminium, beryllium, chromium, zinc, manganese, magnesium, and calcium show that all of these metals but the last two yield basic phosphates. Magnesium forms a double phosphate with sodium. The redissolution of the aluminium precipitate in an excess of precipitant is traced to the formation of sodium aluminate. T. H. P.

2184. *Platini-Platino-Chloride Electrode, New Type of Chlorine Electrode.* **Virginia F. Miller** and **H. Terrey.** (Chem. Soc., J. pp. 605–610, March, 1927.)—Measurement of the potential of the platini-platino-chloride electrode shows that the e.m.f. varies according to the equation

$$E = (E_0 + C) + RT/2F(\beta - 2) \log_{Cl} a + RT/2F \,.\, \log i/o,$$

where β and C are constants. Results of the temperature coefficients of the cell are also given, and by means of the Gibbs-Helmholtz equation the heat of formation of sodium chloroplatinate from the chloroplatinite and chlorine is calculated to be 40,770 or 40,990 cal., the value found by Thomsen by direct heat measurement being 42,000 cal. T. H. P.

2185. *Temperature Coefficient of Contact Electromotive Force.* **J. J. McHenry.** (Phil. Mag. 3. pp. 857–863, April, 1927. Supplement.)—The contact electromotive force E, between clean copper and zinc, is found to be a linear function of the temperature, *viz.*, $E = q + TdE/dt$, where q is very small, being sometimes positive and sometimes negative. It is suggested that the contact e.m.f. is proportional to the absolute temperature for perfectly clean metals. Measurements are also recorded for copper-aluminium and copper-tin cells which, while not so steady as for copper-zinc, confirm the above result. H. H. Ho.

2186. *Influence of Addition of Iodine on the Conductivity of Iodides.* **E. Thönnessen.** (Zeits. f. Physik, 41. 11–12. pp. 810–827, 1927.)—With solutions of cadmium and mercuric iodide in methyl alcohol, potassium iodide in acetone and sodium iodide in amyl alcohol, the addition of small amounts of iodine causes an appreciable increase in conductivity, while higher concentrations cause a large increase. With solutions of potassium iodide in methyl alcohol, and of sodium iodide in acetone, small amounts of iodine cause a depression and larger amounts a considerable increase, though not so large an increase as with the previous class. The increase of viscosity of the solutions by the addition of iodine has a lowering effect on the conductivity. The two opposing main factors, which determine the effect produced by iodine on the conductivity, are the formation of the complex ions I_3^- and I_5^-, which have a low mobility, whereby the conductivity is diminished on the one hand and the influence of the iodine in causing dissociation of such aggregates as $(CdI_2)_n$ whereby the conductivity is increased on the other hand. Cadmium and mercuric iodide in methyl alcohol are not so extensively dissociated as potassium or sodium iodide so that the decomposing action of the iodine predominates. Similarly with potassium iodide in acetone and sodium iodide in amyl alcohol which are not dissociated so largely as in methyl alcohol. The results are held to prove definitely that in all cases the so-called strong electrolytes are not completely dissociated in alcohol or acetone and the evidence is considered to conflict with the general theory of complete dissociation. [See also Abstract 654 (1926).] J. N. P.

2187. *Overpotential at Antimony Kathodes and Electrolytic Stibine Formation.* **H. J. S. Sand, J. Grant** and **W. V. Lloyd.** (Chem. Soc., J. pp. 378–396, Feb., 1927.)—Measurements of the back e.m.f. of polarisation are made during the electrolysis of different solutions with an antimony electrode by means of a mechanically-operated commutator which enables the circuit to be interrupted and the electrode connected to a potentiometer circuit at intervals of $2{\cdot}2 \times 10^{-4}$ sec. The measurements are compared with those given by the direct measurement of the e.m.f. between electrode and electrolyte during continuous electrolysis. It is concluded that the overpotential measured by the direct method at high c.d.'s consist of the sum of a true polarisation, which is almost independent of the c.d., and a term which results from passing the current through a more or less constant resistance at the surface of the electrode. No results of a general nature connecting the production of stibine in acid solutions with overpotential are obtained. Its formation appears to proceed somewhat more readily in alkaline than in acid solutions, and the conditions favourable to it are similar in the two cases. To obtain appreciable yields of the gas, however, it is necessary to blow a rapid current of hydrogen past the electrode in order to carry away the nascent gas before it has been decomposed by the alkaline solution. The decomposition product formed, when this is not done, has the properties of metallic antimony. [See also Abstract 1636 (1924).] J. N. P.

2188. *Electrodeposition Potentials of Alloys of Zinc with Iron, Cobalt and Nickel.* **S. Glasstone.** (Chem. Soc., J. pp. 641–647, March, 1927.)—The results of previous investigators are confirmed that during electrolysis, with gradually increasing current density, of a solution containing zinc and iron or nickel, the initial deposit is mainly the iron group metal. The kathode potential then increases suddenly until it attains a value close to that at which pure zinc is deposited from a solution of a zinc salt; the deposit under these conditions contains only a small proportion of nickel or iron. Similar effects are now observed with zinc and cobalt. The current density at which the sudden increase in potential occurs is generally smaller the lower the temperature, the greater the proportion of zinc in the solution and the lower the *p*H of the solution. The deposition potential of the zinc-rich alloy is measured at various temperatures; this potential decreases with increasing temperature. The sudden increase in kathode potential is attributed to a decrease in the concentration of the nickel, cobalt or ferrous ions in the vicinity of the kathode, with consequent deposition of an alloy richer in zinc and with a high hydrogen overvoltage. [See Abstract 1590 (1927).] L. M. C.

2189. *Passivity.* **H. Eggert.** (Zeits. Elektrochem. 33. pp. 94–102, March, 1927.)—Passivity is defined as the behaviour of a metal, which is capable of dissolving spontaneously in an acid or else anodically with a lower degree of valency, of becoming insoluble in the same medium or dissolving anodically with a higher degree of valency or not at all. Experiments are arranged in which metal plates can be abraded and employed as anodes in a gas atmosphere which can be controlled. With iron, nickel, or chromium in an electrolyte in water, methyl, alcohol or pyridine, after treatment in this manner the potential is lowered but increases gradually with time and on repeated abrasion reaches finally a minimum value. If oxygen is admitted to the metal the potential increases rapidly, and on scratching falls but rises again rapidly to the high value. Iron and nickel anodes dissolve in lithium chloride solutions in water or alcohol in accordance with their electrochemical equivalents, while chromium dissolves as chromic acid and is thus passive. Iron and nickel are active in lithium chloride solution in anhydrous pyridine and passive in silver nitrate solution, but in presence of traces of water oxidation of the metal occurs forming a non-conducting layer at the kathode. Chromium, when abraded in completely dry nitrogen or hydrogen, maintains its activity as long as it remains in the gas, but after a short interval in air becomes passive. Chromium is activated and maintains its activity by heating in completely dry hydrogen or nitrogen but rapidly becomes passive on contact with air. J. N. P.

2190. *Electrolysis of Aqueous Solutions of Pure Oxalic Acid.* **E. Doumer.** (Comptes Rendus, 184. pp. 747–749, March 21, 1927.)—A certain proportion of oxygen is always liberated at the anode in addition to carbon dioxide in the electrolysis of dilute aqueous oxalic acid solutions. The volume of this oxygen varies with the current density between one-fourth and one-half of the volume of the hydrogen liberated at the kathode. This can be explained by assuming that the water itself is ionised to a considerable extent, with the result that ions of COOH and OH react, forming oxalic acid and liberating oxygen, this reaction being favoured by higher current densities and proceeding simultaneously with the decomposition of the COOH ions which liberates carbon dioxide. B. W. C.

2191. *Current Density and Yield in the Formation of Ammonium Persulphate.* **O. Essin and E. Krylow.** (Zeits. Elektrochem. 33. pp. 107–111, March, 1927.)—It was shown in a previous paper that the current yield of ammonium persulphate in a saturated solution of ammonium sulphate does not depend on the current density at temperatures between 10° and 30° C. [See Abstract 2493 (1926).] Continuing the work, it is demonstrated that the yield is given by the equation

$$A = \left(\frac{c_0 - 2c_2}{c_0 - c_2} - K\right) . 100\,\%$$

for this range of temperature. In the formula K is a constant for each current density D, and shows the quantity of SO_4'' ions which do not form persulphate. The theory of probability leads to the following expression for K:

$$K = 1 - \int_0^{L_1} e^{-L^3} L^2 dL, \text{ where } L = 1 \cdot 9D^{1/3}.$$

The conclusion is arrived at that the formation of S_2O_8'' requires a particular density in the arrangement of the discharge SO_4'' so that they may be within the sphere of their chemical action. F. J. B.